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Is that calf waving or drowning?

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In recent years a lot of important work has been completed in an attempt to quantify the pain associated with routine surgical farm procedures, such as disbudding or castrating, with the objective of identifying more humane and acceptable practices (McMeekan et al 1999, Sylvester et al 2004). Many of the pain evaluation methods used are however highly subjective and rely on interpreting an animal's behaviour as evidence of pain. The following behavioural activities are often cited as evidence of pain, ear flicking, tail swishing, head shaking, foot stamping, nibbling, and lying down, whereas grazing or ruminating are usually construed as evidence that the animal is pain free (Graf and Senn 1999, McMeekan et al 1999). Being subjective all these methods are potentially tainted by observer bias, in which researchers see a behavior and interpret it according to what it means to them, whereas it may mean something else to the animal showing the behavior.
A small pilot study was undertaken on 31st Oct 2007 at Massey Dairy Cattle Research Unit (DCRU) to evaluate whether low-dose aspirin could be used as a cheap NSAID in conventionally farmed calves and which of the homeopathic remedies arnica or hypericum could be more effective for alleviating pain in organic calves. Pain evaluation was based on observation of behaviour using the methods described by McMeekan et al 1999.

Materials and methods

Twenty 8 to 12 week old Friesian or crossbred conventional calves and fifteen 8 to 12 week old Friesian or crossbred organic calves from Massey DCRU were used for this study. All calves, whether conventional or organic, were dehorned in a similar fashion. Each calf was manually restrained in a race and given a cornual nerve block (2.5 ml of 2% lignocaine hydrochloride; Nopaine, Phoenix Pharm Distributors Ltd, Auckland, New Zealand) and then held in a head bail for surgery. The time between nerve block and surgery was at least 5 minutes. Smaller horns were removed with a propane gas dehorner (Te Pari calf dehorners, Te Pari Products, Oamaru, New Zealand), with the horn bud 'flicked out' as the end point, whereas larger horns were first amputated using a Barnes scoop dehorner (Shoof International Ltd, Cambridge, New Zealand) and then cauterised with the same gas dehorner. Immediately after surgery the wounds on the conventional calves were dressed with Aerotet forte (Virbac Laboratories (NZ) Ltd, Auckland, New Zealand) and the wounds on the organic calves were dressed with Vetadine iodine spray (Bomac Laboratories Ltd, Auckland, New Zealand). The conventional calves were randomly allocated to receive either 20mg/kg aspirin (Disprin Max, Reckitt Benckiser, Auckland, New Zealand) dissolved in one litre of water given by oesophageal feeder or nothing; the organic calves were randomly allocated to have either 200c arnica (HFS Ltd, Hamilton, New Zealand) or 200c hypericum (HFS Ltd, Hamilton, New Zealand) given by direct spraying onto the calf's muzzle. All treatments were given when the calf was caught in the head bail, just prior to surgery. Both use of the Barnes scoop dehorner and whether the student administered corneal nerve block appeared effective or not (judged by the escape behaviour/vocalisation of the calf) was recorded. After surgery

the conventional and organic calves were kept separate and returned to different paddocks.
Post-operatively a group of students (with binoculars) observed each calf consecutively for 1 minute at 2, 4 and 6 hours after surgery. The students recorded whether each calf was lying/standing, grazing/ruminating, head shaking, foot stamping, tail swishing or grooming and the number of times each activity was repeated during each minute of observation. It is important to note that the same students carried out both the surgery and the observations and so were at least partially aware of treatment groups.

Statistical analysis

The statistical analysis was performed with PROC GENMOD in SAS version 9.1 (SAS Institute Inc., 1999). Generalized estimating equations (GEE) were used, whereby the relationship between the response and covariates is modelled separately from the correlation between repeated measurements on the same individual (Diggle 2002). The correlation between successive measurements is modelled explicitly by assuming a "correlation structure" or "working correlation matrix". The assumption of a correlation structure facilitates the estimation of model parameters. Examples of working correlation matrices include: exchangeable, auto-regressive of order 1 (AR(1)), unstructured, and independent correlation structures. Details of the correlation structure and response-covariate relationship are included in an expression known as the *quasi-likelihood function*, which is iteratively solved to obtain parameter estimates. The observations collected at 2, 4 and 6 hours post surgery were used to build a response profile for each animal. A negative binomial distribution with a log link was used to model the count data (too over-dispersed for a poisson distribution) and the proportion data was modelled with a binomial distribution and a logit link. Since there was no prior belief about the dependency between observations on the same calf an unstructured correlation structure was used.
Treatment and time were entered into the model ‘a priori’, the other two covariates ‘use of scoop dehorners’ and ‘efficacy of cornual nerve block’ were tested in the model and retained at $p<0.05$. Interactions between significant variables were also tested.

Results

The proportion of calves observed ruminating or grazing, lying down or grooming and the average observed counts of tail swishing, ear shaking, headshaking and foot stomping 2, 4, and 6 hours after surgery are shown in Table 1.

Table 1 Proportion of animals observed ruminating or grazing, lying down or grooming and the average observed counts of tail swishing, ear shaking, headshaking and foot stomping 2, 4, and 6 hours after surgery

		Proportion of animals observed			Average count of each activity observed			
Treatment	Time(h)	Ruminating or grazing	Lying down	Grooming	Tail swishing	Ear shaking	Headshaking	Foot stomping
Aspirin	2	0.00	0.60	0.00	5.8	6.2	0.2	0.2
	4	0.22	0.89	0.22	2.3	8.2	1.7	0.0
	6	0.20	0.70	0.00	1.1	7.4	1.7	0.0
Control	2	0.40	0.10	0.00	11.0	6.7	0.4	0.4
	4	0.40	0.80	0.10	2.3	5.2	1.0	0.1
	6	0.30	0.30	0.00	4.8	8.4	0.4	0.0
Arnica	2	0.13	0.25	0.00	9.1	4.6	0.1	1.4
	4	0.25	0.50	0.25	6.9	7.5	1.5	0.0

	6	0.13	0.25	0.00	1.5	3.9	0.1	0.0
Hypericum	2	0.00	0.14	0.00	7.0	1.3	1.1	1.9
	4	0.33	0.71	0.29	4.4	4.9	0.1	0.0
	6	0.43	0.14	0.00	1.3	0.4	0.0	0.0

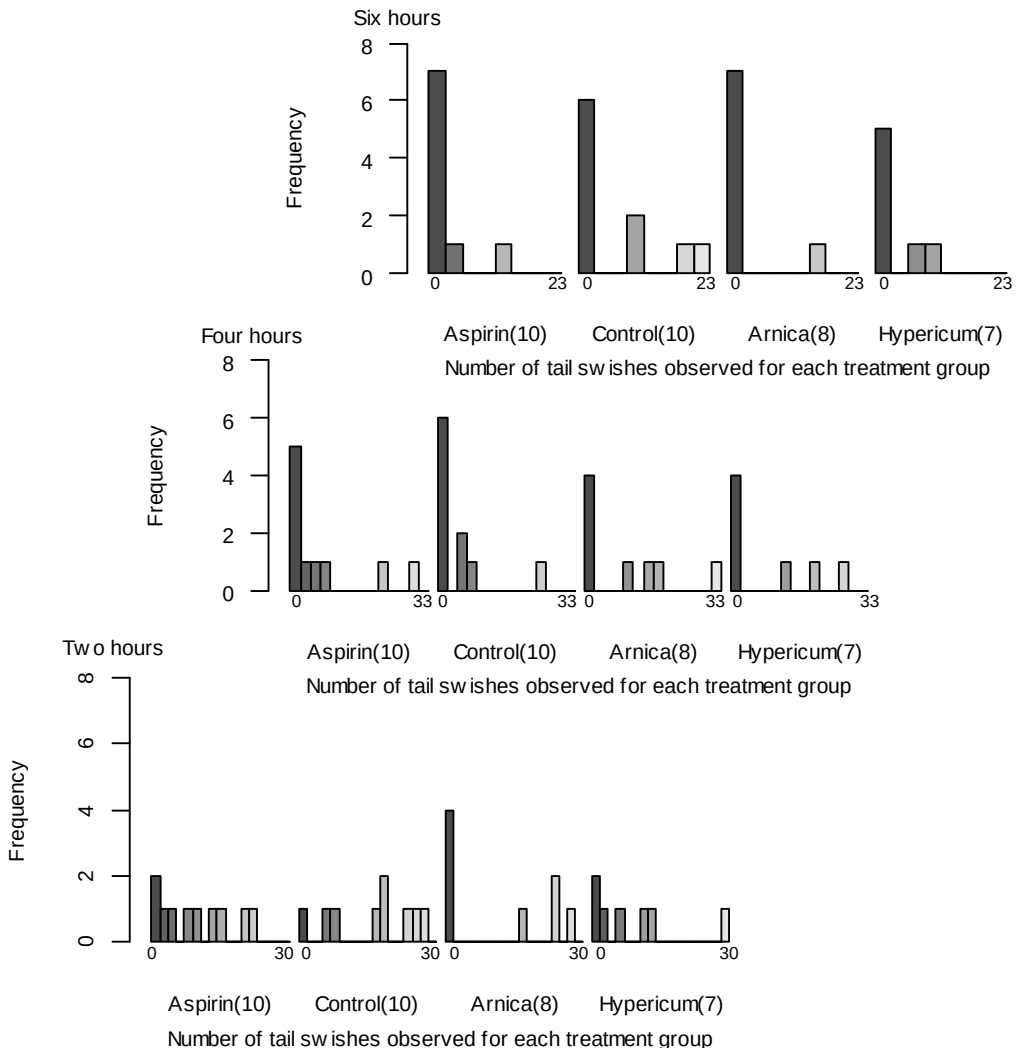

Figure 1 Frequency of counts of tail swishes observed in calves at 2, 4 and 6 hours post disbudding for each treatment group with group size shown in brackets. The range under each treatment bar plot is from 0 to 30 for observations at two hours, 0 to 33 for observations at four hours and 0 to 23 for observations at six hours.

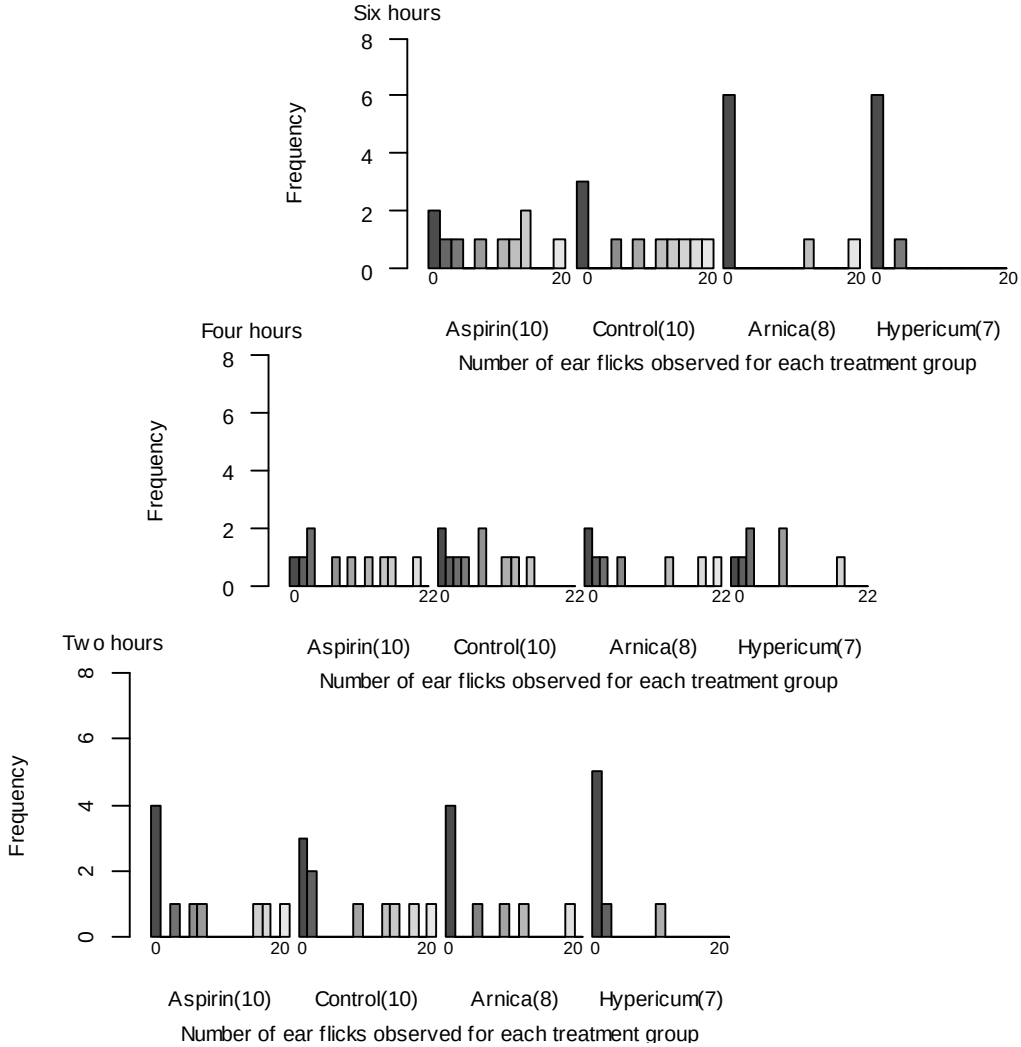

Figure 2 Frequency of counts of ear flicks observed in calves at 2, 4 and 6 hours post disbudding for each treatment group with group size shown in brackets. The range under each treatment bar plots is from 0 to 20 for observations at two hours and six hours and 0 to 22 for observations at four hours.

Both Figures 1 and 2 show that the counts were zero-inflated with 53/105 zeroes for tail swishing and 39/105 zeroes for ear flicking

The results showed that in the first 6 hours after surgery conventional calves treated with aspirin were more likely to be lying down OR=4.4 (95%CI 1.3-14.9), that calves dehorned without scoop dehorners were likely to have more tail swishes OR=2.0 (95%CI 0.9-4.3), more ear flicks OR=1.8 (95%CI 1.1-3.2) and more head shakes OR=2.8 (95%CI 1.1-6.8) and that organic calves treated with arnica were likely to have more ear flicks OR=2.6 (95%CI 1.1-6.5) than those treated with hypericum.

DiscussionThis was a very small study which would have almost certainly included some observational bias. Although clearly tempting, without the opportunity to randomise treatments across all groups it is not possible to make any comparisons between treatments given to the conventional and organic calves. It is also important to note that the calves were only observed for six hours and the question remains whether the pain response was postponed, reduced or ablated altogether.

There is no evidence from this study that aspirin at a dose of 20mg/kg has a noticeable analgesic effect in the first six hours after surgery and it is even possible that the aspirin had a negative effect, potentially through gastric mucosa irritation, with more calves lying down in the aspirin treated group. In cattle practice the use of NSAIDs as analgesics has become common (Stafford and Mellor, 2005, 2007), although cost, as always, remains an issue in all types of veterinary practice. The availability of cheap and effective analgesics such as aspirin could increase the use of NSAIDs for routine farm surgeries.

The reduction in ear flicking, head shaking and tail swishing observed when the scoop dehorners were used is interesting and would appear to contradict other studies that have identified scoop dehorning as a more painful procedure than simple disbudding (Stafford and Mellor, 2004). However the 'flicking out' of the horn-bud technique used in this study is almost a form of scoop dehorning in itself but with a relatively longer exposure time to the hot iron. This may indicate that in 'field' situations the use of scoop dehorners could be a less painful alternative to some disbudding techniques.

The finding that 200c hypericum may have some advantages over 200c arnica (presupposing either works at all) could be of interest to organic farmers. Hypericum is prepared from St. John's-wort and is indicated for pain after surgery and lacerated injuries especially around the head (Verkade, 2002). There was no effect of 'poor efficacy of cornual nerve block' in any of the models and may indicate that Massey veterinary students are proficient in a technique of 'delayed cornual nerve block' , alternatively this may support the observation of Vickers et al 2005 that local anaesthesia provides poor pain relief for calf dehorning.

As far as the authors could ascertain this is the first occasion that GEE procedures have been used to analyse data from painful procedure experiments. GEE methodology provides a practical strategy for the analysis of repeated measurements and can cope with both continuous and categorical explanatory variables and missing data. However since the dataset was characterised by a high proportion of zero counts, the use of hurdle or zero-inflated models, possibly with random effects, should also be explored in the future.

In conclusion the low-dose aspirin used in this study did not produce any observable reduction in painful behaviour and may even have had a negative effect. The findings in other studies that scoop dehorning is a more painful procedure may well depend on which disbudding technique is used for comparison. Fully randomised trials are required to evaluate the efficacy of homeopathic treatments such as hypericum.

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