

## Inside this issue

*Infrared thermography and heart rate variability for non-invasive assessment of animal welfare* 1

*Guidelines to promote the wellbeing of animals used for scientific purposes: The assessment and alleviation of pain and distress in research animals* 4

*AAWS 2008 International Animal Welfare Conference* 5

*News from NZ* 6

- NAEAC Annual Report

*News from Overseas* 6

- 2008 Humane Education Award

## Infrared thermography and heart rate variability for non-invasive assessment of animal welfare

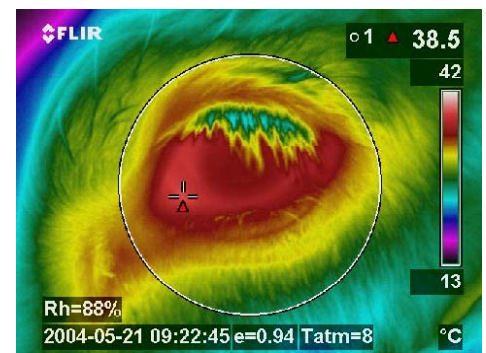
Stewart M<sup>1\*</sup>, Webster J.R.<sup>1</sup>, Schaefer A.L.<sup>2</sup> and Stafford K.J.<sup>3</sup>  
<sup>1</sup>AgResearch Ltd, Hamilton, New Zealand [mairi.stewart@agresearch.co.nz](mailto:mairi.stewart@agresearch.co.nz),  
<sup>2</sup>Agriculture and Agri-Food Canada, Lacombe, Alberta, Canada

### Introduction

The assessment and alleviation of pain and stress during and following routine husbandry procedures used on farms (e.g., disbudding and castration of calves) are important components of farm animal welfare. Despite evidence which demonstrates the welfare benefits of using analgesics, in most countries it is still common practice and legal to conduct procedures such as disbudding, dehorning and castration of young calves without pain relief. There are many reasons why there is a lack of use of analgesics in farm animals including practical and economical factors.

The assessment and management of pain in farm animals has been reviewed previously (e.g., Mellor et al., 2000; Vinuela-Fernandez et al., 2007). A major issue for animal welfare research is that many of the techniques used to measure stress and pain involve invasive procedures, such as blood sampling, that may cause a stress response themselves and there is a lack of reliable, non-invasive tools (Stewart et al., 2005). In order to improve animal welfare, new technologies and tools to evaluate the welfare impact of different husbandry practices are necessary.

This article provides a brief review of a series of experiments that investigated a novel combination of eye temperature (using infrared thermography, IRT) and heart rate variability (HRV, using Polar S810i™) as a non-invasive tool to detect pain. For more detail the reader is referred to a series of recent papers (Stewart et al., In Press; Stewart et al., 2005; Stewart et al., 2007; Stewart et al., 2008). The main approach was to measure eye temperature and HRV responses of cattle during routine husbandry practices (e.g., cautery disbudding and surgical castration) with and without local anaesthetic. IRT detects heat emitted from superficial capillaries around the eye as blood flow is regulated under autonomic control, (Figure 1).



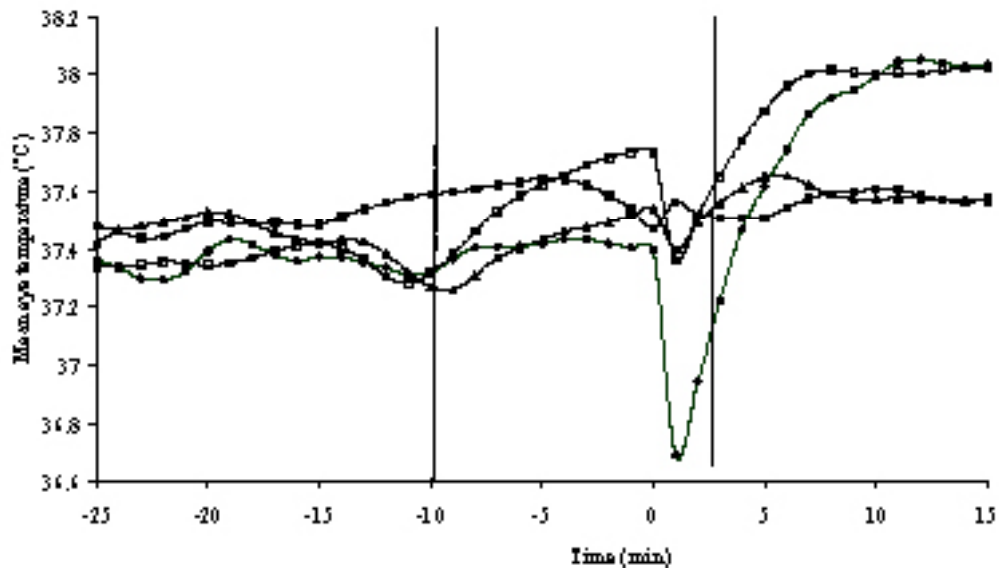
**Figure 1.** Infrared image of the eye region of a dairy calf

HRV provides a more detailed measure of a stress response than heart rate alone as it is possible to measure the balance between sympathetic and parasympathetic tone, therefore providing a more detailed interpretation of autonomic activity (von Borell et al., 2007).

### Results and discussion

Responses to pain following disbudding without local anaesthetic included a rapid drop in eye temperature (Figure 2), a prolonged heart rate increase (up to 3 hrs) and an acute HRV response [reduced high frequency (HF) power and increases in the low frequency (LF) power and the LF/HF ratio] that indicated an acute change in the sympatho-vagal balance with a possible shift towards increased sympathetic activity (Stewart et al., 2008).

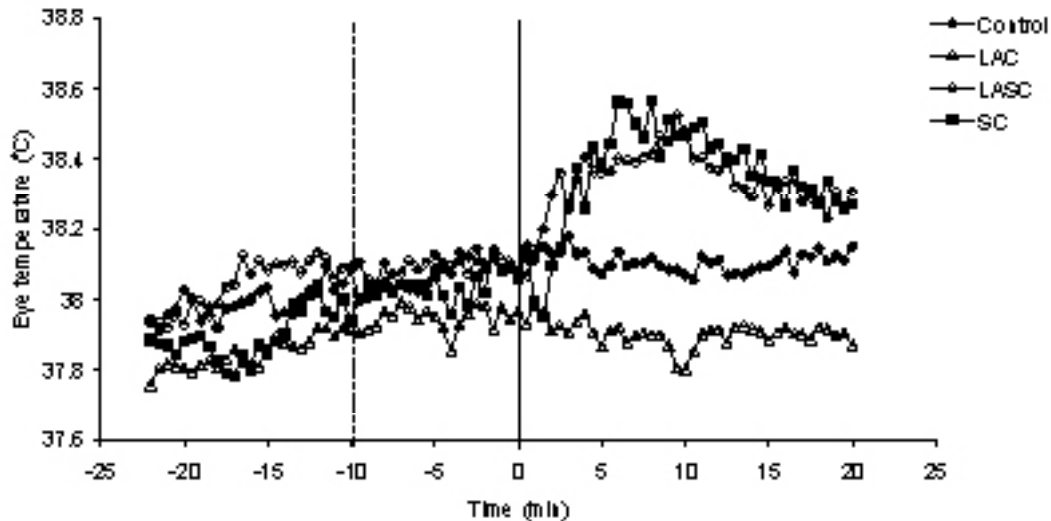
When calves were disbudded with local anaesthetic, a drop in eye temperature was also detected when local anaesthetic wore off after 2 hours, due to the onset of pain at this time. This drop in eye temperature was accompanied by an increase in heart rate and sympathetic activity (increased LF and LF/HF ratio) and a decrease in lying behaviour and parasympathetic tone (decreased HF). We hypothesised that the drop in eye temperature was caused by the redirection of blood from the capillary beds via sympathetically-mediated vasoconstriction. The role of the autonomic nervous system was confirmed by a drop in eye temperature that occurred following an infusion of epinephrine.



**Figure 2.** Eye temperature (°C) for control (■, n=8), local anaesthetic control (▲, n=8), disbudded with local anaesthetic (□, n= 8) and disbudded without local anaesthetic (●, n=6). The dashed vertical line indicates the time that local anaesthetic or the sham procedure was administered and 0 min indicates the time of treatment. (From Stewart et al. (2008))

Following castration without local anaesthetic, there was an increase in eye temperature (Figure 3) and an increase in parasympathetic tone (increase in the root mean square of successive R-R interval differences and HF and decrease in LF and LF/HF ratio). It is possible that the increase in eye temperature is due to parasympathetically-mediated vasodilation. The marked increase in parasympathetic tone after castration may be associated with deep visceral pain

due to the stretching and tearing of the spermatic cords, as the parasympathetic nervous system carry noxious impulses from the pelvic viscera, including the testes (King, 1987). The parasympathetic nervous system acts to lower cardiac output and blood pressure, resulting in vasodilation, and an increase in eye temperature. However, further research is required to confirm the exact mechanism for this response.



**Figure 3.** Eye temperature (°C) for control (●, n=8), castrated without local anaesthetic (■, n=6), local anaesthetic control (Δ, n=8) and castrated with local anaesthetic (○, n=8). 0 min indicates the time of treatment.

### Summary and conclusions

This research showed that during stress or pain, the heat emitted from superficial capillaries around the eye changes as blood flow is regulated under autonomic nervous system control and these changes can be quantified using IRT. A combination of IRT and HRV were able to non-invasively detect different autonomic responses to different aversive procedures. Somatic pain from disbudding caused acute sympathetic responses and prolonged HR elevation, whereas, deeper visceral pain caused by castration caused a short-lived HR increase and increased eye temperature and parasympathetic tone. There are many factors that could influence these different physiological responses, such as the location of the pain and the type of tissue involved, different intensities of pain and the level of fear associated with the particular procedure. Eye temperature and HRV, offer advantages over other indicators of stress and pain due to the ability to non-invasively collect data with little interference, therefore minimising the confounding factors associated with other measures. A combination of eye temperature and HRV measures may be a complementary index to other indicators currently used to measure pain and stress, and could replace invasive procedures, such as measurement of plasma catecholamines, to measure autonomic responses for assessing animal welfare.

This combination may provide more sensitive, detailed and immediate measures of acute pain than changes in hypothalamic-pituitary-adrenal axis activity and could have wider applications to test the efficacy of analgesics and measure animal emotions.

### References

- King, A.S., 1987. Physiological and clinical anatomy of the domestic mammals. Vol 1. Central nervous system. Oxford University Press, Oxford, UK.
- Mellor, D.J., Cook, C.J., Stafford, K.J. 2000. Quantifying some responses to pain as a stressor. In: Moberg, G.P., Mench, J.A. (Eds.), *The biology of animal stress: basic principles and implications for animal welfare*, CABI Publishing, Wallingford, UK, pp. 171-198.
- Stewart, M., Schaefer, A.L., Haley, D.B., J.J., C., Cook, N.J., Stafford, K.J., Webster, J.R., *Infrared thermography as a non-invasive method for detecting fear-related responses of cattle to different handling procedures*. *Anim. Welf.* (In Press).
- Stewart, M., Stafford, K.J., Dowling, S.K., Schaefer, A.L., Webster, J.R., 2008. Eye temperature and heart rate variability of calves disbudded with or without local anaesthetic. *Physiol. Behav.* 93, 789-797.

- Stewart, M., Webster, J.R., Schaefer, A.L., Cook, N.J., Scott, S.L., 2005. Infrared thermography as a non-invasive tool to study animal welfare. *Anim. Welf.* 14, 319-325.
- Stewart, M., Webster, J.R., Verkerk, G.A., Schaefer, A.L., Colyn, J.J., Stafford, K.J., 2007. Non-invasive measurement of stress in dairy cows using infrared thermography. *Physiol. Behav.* 92, 520-525.
- Vinuela-Fernandez, I., Jones, E., Welsh, E.M., Fleetwood-Walker, S.M., 2007. Pain mechanisms and their implication for the management of pain in farm and companion animals. *Vet. J.* 174, 227-239.
- von Borell, E., Langbein, J., Despres, G., Hansen, S., Leterrier, C., Marchant-Forde, J., Marchant-Forde, R., Minero, M., Mohr, E., Prunier, A., Valance, D., Veissier, I., 2007. Heart rate variability as a measure of autonomic regulation of cardiac activity for assessing stress and welfare in farm animals - A review. *Physiol. Behav.* 92, 293-316.



Mairi Stewart being presented with the 2008 ANZCCART Student Award for best abstract of a paper provided by an honours or post-graduate student in New Zealand or Australia by Dr Chris Prideaux, Chairman of the ANZCCART Board at the ANZCCART Conference recently held in Auckland.

## **Guidelines to promote the wellbeing of animals used for scientific purposes: The assessment and alleviation of pain and distress in research animals**

Michele Walter, Animal Welfare Unit  
Department for Environment and Heritage  
South Australia

Like all relevant State and Territory Government departments around Australia in recent years, the South Australian Animal Welfare Unit has observed an increased awareness of the legal and ethical requirements for ensuring the wellbeing of animals in licensed research and teaching institutions among all stakeholders. Animal Ethics Committees (AECs), researchers and teachers have a good general knowledge of what constitutes the most humane treatment for animals in their care. More recently, the external review process has examined the way institutions and their AECs meet their broad range of responsibilities under the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes. The outcomes of these reviews have in most cases, highlighted some areas where further improvement may be possible. It is in this light that we have welcomed the recent release of the National Health and Medical Research Council's "*Guidelines to promote the wellbeing of animals used for scientific purposes: The assessment and alleviation of pain and distress in research animals*".

These guidelines will fortify the Australian Code of Practice by compelling further consideration of the behavioural as well as biological needs of the animals and by providing them with a safe and an enriched environment to minimise their experience of pain and distress. The guidelines have been developed by a working group consisting of Animal Welfare Committee members, researchers and experts from institutions and animal care authorities, and after extensive public consultation, were released on 5 June 2008.

Importantly, the guidelines provide a clear structure for the consideration and practical application of the 3Rs (replacement, reduction and refinement). The inclusion of flow charts, checklists and fact sheets and the use of plain English all help to ensure that each section is

---

readily accessible and easily understood. The fact sheets provide species-specific biological information, advice on housing, feeding and handling tips. The administration of substances, scientific procedures (such as blood taking), humane killing and euthanasia are all addressed. The Guidelines also highlight potential risks to the reliability/validity of research data when unintended pain or distress occurs.

The challenges of wildlife research have prompted the writing group to include a specific section with the key elements that set these studies apart from other kinds of research addressed in detail. This is something that will be seen as very valuable to many investigators and certainly members of AECs that assess proposals in this area.

Whilst the use of animals for teaching purposes in schools, colleges and tertiary institutions is not explicitly addressed, teachers may find many sections including stress and distress, housing and husbandry, monitoring and environmental enrichment informative. It should however be noted that the Guidelines have been specifically designed as a "living document" with the provision for regular updates and / or revisions being published via the NHMRC website. This is an excellent strategy for guidelines of this type and will hopefully mean that the area of animal use in schools will be more fully addressed in one of these updates.

The Guidelines will also provide external reviewers with an additional benchmarking tool that will help ensure that AECs, licensed institutions, researchers and teachers conduct their use of animals responsibly and meet the broad range of responsibilities now included in the Australian Code. As with all such documents published by the NHMRC, these Guidelines carry a reminder that they should be read in conjunction with the *Australian Code of Practice for the Care and Use of Animals for Scientific Purposes*, 2004.

---

## **AAWS 2008 International Animal Welfare Conference**

The first International Animal Welfare Conference, The Welfare of Animals - It's Everyone's Business. AAWS the Australian Approach, will be held at the Gold Coast, Queensland from 31 August to 3 September 2008.

Animal welfare is everyone's responsibility and touches all members of the Australian Community. This is the first conference of its type domestically or internationally and it will bring together animal welfare stakeholders from across the globe.

### **The Program**

The three day program will include plenary and interactive panel sessions as well as workshops or stream sessions covering the six AAWS animal use sectors: animals in the wild, livestock production, companion animals, animals used for work, sport or recreation, aquatics and research and teaching. The conference will feature national and international speakers from industry, animal welfare groups, government and research.

### **Conference Aim**

The 2008 International Animal Welfare Conference aims to bring together animal welfare stakeholders from around the world and provide them with an opportunity to improve animal welfare domestically and internationally. The conference will provide a forum to share ideas and discuss future priorities.

### **Recommended for**

All AAWS stakeholders including:

- industry
- Government
- Research
- Animal welfare groups

### **Further information**

Animal Welfare Unit  
Department of Agriculture, Fisheries and Forestry

[www.daff.gov.au/aaws08](http://www.daff.gov.au/aaws08)

---

## News from New Zealand

### NAEAC Annual Report

The National Animal Ethics Advisory Committee (NAEAC) Annual Report was released last week.

A significant feature of NAEAC's work in 2007 was the review of a number of the codes of ethical conduct that govern the use of animals in research, testing and teaching.

The Annual Report publishes the notification of the numbers of animals used in research, testing and teaching. The overall number of animals manipulated in 2007 has decreased from the previous year by 22.6% to 246,667. Year on year fluctuations can in large part be attributed to the three year reporting cycle for long term projects. A rolling average shows little variation from the previous three years.

A copy of the Report is available at:

<http://www.biosecurity.govt.nz/files/regs/animal-welfare/pubs/naeac/naeac-ar-07.pdf>

---

## News from Overseas

### 2008 Humane Education Award

InterNICHE announces the 2008 Humane Education Award to support ethical and effective life science education and training.

The Award is a grant program to enhance biological science, medical and veterinary medical education and training. Supported by Proefdiervrij, the Award offers 20,000 Euro (US\$ 25,000) to be split between successful applicants.

Proposals are invited from all countries for initiatives to replace animal experiments and the dissection of purposely killed animals. Applicants may be teachers, students, campaigners or any other individuals committed to best practice education and training.

50% of the Award is available in Part A, and 50% in Part B:

Deadline for Part A has now closed  
Deadline for Part B: 15 November 2008

Applications must be submitted through the on-line form at [www.interniche.org/award/2008award.htm](http://www.interniche.org/award/2008award.htm) and also sent as an e-mail with attachment to [coordinator@interniche.org](mailto:coordinator@interniche.org). Questions about the Award may be sent to InterNICHE at [coordinator@interniche.org](mailto:coordinator@interniche.org). Further information on InterNICHE, alternatives and humane education can be found at: [www.interniche.org](http://www.interniche.org)

### **ANZCCART NEWS ©**

**is free of charge and is published by the  
Australian and New Zealand Council for the Care of  
Animals in Research and Teaching Limited.**

**It is a publication for researchers and teachers;  
members of Animal Ethics Committees; staff of  
organisations concerned with research, teaching  
and funding; and parliamentarians and members of  
the public with interests in the conduct of animal-  
based research and teaching and the welfare of  
animals used.**

**The opinions expressed in ANZCCART NEWS are  
not necessarily those held by ANZCCART Ltd.**

**Contributions to ANZCCART NEWS are welcome and  
should be sent to:**

### **ANZCCART**

**C/- The University of Adelaide  
South Australia 5005  
Australia**

**Tel. 61-8-8303 7585 Fax. 61-8-8303 7587**

**E-mail. [anzccart@adelaide.edu.au](mailto:anzccart@adelaide.edu.au)**

**<http://www.adelaide.edu.au/ANZCCART>**

**or**

**ANZCCART New Zealand  
PO Box 598  
Wellington  
New Zealand**

**Tel. 64-4-472 7421 Fax. 64-4-473 1841**

**E-mail. [anzccart@rsnz.org](mailto:anzccart@rsnz.org)**

**<http://www.rsnz.org/advisory/anzccart/>**

**ISSN 1039-9089**