Can eye surface temperature be used to indicate a stress response in harbour seals (Phoca vitulina)?

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Abstract

Infra-red thermography (IRT) is increasingly being used to estimate physiological stress responses in animals via changes in eye surface temperature. The aim of this study was to determine whether eye temperature of harbour seals (Phoca vitulina) changes in response to routine handling and the potentially painful procedure of flipper-tagging, and if responses to tagging can be mitigated by subcutaneous injection of lidocaine. Orphaned pups (n = 52) at a rehabilitation facility were assigned to one of four treatments: Lidocaine (handled twice, once for injection and once for tagging); Saline (also handled twice); Tag Only (handled once); Sham Tag (handled once). Eye temperature increased more when pups were first handled compared to pups that were not handled and increased further in pups that underwent a second handling. Eye temperature of pups that were tagged without any previous treatment (Tag Only) increased compared to pups that were sham-tagged. Eye temperature also tended to increase after pups were injected with lidocaine but not saline. These results suggest that: (i) handling causes a physiological stress response; (ii) increased eye temperature arising from the second handling suggests the first handling was likely aversive, resulting in sensitisation to further handling; (iii) the rise in eye temperature after tagging, but not sham-tagging, may reflect pain from tagging; and (iv) lidocaine, at the dosage tested, did not appear to reduce the physiological response to tagging. These results show promise for the use of eye temperature to monitor stress responses and for evaluating the potential aversiveness of routine procedures in seals.

Keywords: animal welfare, eye temperature, handling, harbour seal, pain, stress response

Introduction

The assessment of potentially painful or aversive husbandry procedures typically relies on a combination of physiological and behavioural measures (Rutherford 2002). Unfortunately, many of these measures are time-consuming and may require handling or sampling which can themselves result in stress responses (Stewart et al 2005). As an alternative, infra-red thermography (IRT) is increasingly recognised as a reliable, non-invasive method to detect changes in heat emission, especially from around the eye, as an indication of physiological stress responses in animals (Stewart et al 2010). For many years, IRT has been used successfully to identify inflammatory injury and disease in veterinary medicine (McCafferty 2007) and, increasingly, to measure stress responses in animals via changes in local vascular perfusion. There is evidence that both physiological and psychological stress are accompanied by changes in eye temperature (Cook et al 2001; Pavlidis & Levine 2002) and that eye temperature may reflect the activity of both the autonomic nervous system (ANS) and the hypothalamic-pituitary-adrenal (HPA) axis (Cook et al 2001; Stewart et al 2008a,b). Short-term eye temperature changes due to changes in peripheral blood flow are associated with the ANS and may be a physiological correlate of an animal’s affective state, for example, in response to painful, stressful or arousing stimuli (Stewart et al 2008a). In such cases a change in the amount of blood flow through peripheral vasculature influences the temperature of the local skin and extremities leading to a change in the amount of heat radiated from affected surfaces that can be measured with IRT. The eye and, in particular, the areas of the lacrimal caruncle and palpebral border of the ventral eyelid, have been recognised as being particularly sensitive to changes in blood flow from stress responses (Pavlidis & Levine 2002; Stewart et al 2008b). For example, changes in eye temperature have been recorded in horses (Equus caballus) (Dai et al 2015) and cattle (Bos taurus) (Stewart et al 2008a) in response to fear-producing stimuli, in horses after aversive procedures such as coat-clipping (Yarnell et al 2013) and the application of...