Plasma cortisol and noradrenalin concentrations in pigs: automated sampling of freely moving pigs housed in the PigTurn® versus manually sampled and restrained pigs

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Abstract

Minimising the effects of restraint and human interaction on the endocrine physiology of animals is essential for collection of accurate physiological measurements. Our objective was to compare stress-induced cortisol (CORT) and noradrenalin (NorA) responses in automated vs manual blood sampling in pigs. A total of 16 pigs (30 kg) were assigned to either: (i) automated blood sampling via an indwelling catheter using a novel-penning system called PigTurn® which detects the pig’s rotational movement and responds by counter-rotating, allowing free movement while preventing catheter twisting; (ii) automated sampling while exposed to visual and auditory responses of manually sampled pigs; or (iii) manual sampling by jugular venipuncture while pigs were restrained in dorsal recumbency. During sampling of (i), personnel were not permitted in the room; samplings of (ii) and (iii) were performed simultaneously in the same room. Blood samples were collected every 20 min for 120 min and measured for CORT (ng ml–1) using mass spectrometry and NorA (pg ml –1) using High Performance Liquid Chromatography (HPLC). Effects of treatment and time were computed with mixed models adjusted by Tukey post hoc. CORT and NorA concentrations were lowest in group (i) followed by group (ii), which were not different. However, CORT and NorA levels in manually sampled animals (iii) were highest compared to automated methods (i) and (ii). Plasma concentrations across time were not different for CORT, but NorA concentration at time 0 min was higher than at 120 min. The presence of visual and auditory stimuli evoked by manual sampled animals did not affect non-handled pigs’ responses. Restraint and manual sampling of pigs can be extremely stressful while the automated blood sampling of freely moving pigs, housed in the PigTurn® was significantly less stressful for the animals.

Keywords: animal welfare, blood sampling, cortisol, noradrenalin, pigs, restraint

Introduction

The development of drugs for medical purposes is a long and extremely costly process and invariably uses animal experimentation. The current estimated cost for bringing a new drug safely to market is about US$1.8 billion (Paul et al 2010), with less than 1 in 10,000 investigated compounds making it all the way from being an initial compound of interest to a medicine in clinical use (GAO 2006). The majority of compounds fail during the first two stages of development, namely the drug discovery and preclinical stages (which includes animal testing), with perhaps only 250 compounds beginning the clinical trial stage. All research involving the use of animals in the preclinical stage should be guided by the three chief principles of humane technique, as described by Russell and Burch (1959), namely those of Replacement, Reduction and Refinement — commonly referred to as the ‘Three Rs’. From an animal welfare standpoint, the greater the use of replacement methodologies and/or the refinement of data collection in animal studies that decreases data variation, the greater will be the reduction of animal use. From an economic standpoint, if refinement results in better science that leads to earlier prediction of potential clinical failure, it will reduce the amount of wasted financial investment in further drug development.

The vast majority of animal species used in animal experiments continues to be rodents. In the UK, which has the most comprehensive animal-reporting statistics, just over 80% of