

Primate Welfare Meeting

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Central London


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NC3Rs
National Centre for the Replacement, Refinement
and Reduction of Animals in Research

Welcome

Dear Colleagues,

Welcome to the seventh NC3Rs Primate Welfare Meeting. This meeting brings together scientists, veterinarians, animal technicians, facility managers and policy makers with a common interest in the welfare of laboratory-housed non-human primates. The broad aims of the meeting are to –

- support the development and implementation of refinements in primate care and use
- provide evidence that can be used to promote improvements in primate welfare and direct welfare research
- bring people together to establish new contacts and for exchange of views and information on primate issues

The Primate Welfare Meeting is just one of several activities of the NC3Rs focused on the use of non-human primates in research (see www.nc3rs.org.uk/primatewelfare and www.nc3rs.org.uk/primatesabpi).

We are pleased that this meeting has again attracted so many delegates, including many from overseas. The programme features presentations from international speakers on a variety of welfare topics, from new methods of pain assessment, to opportunities to avoid restraint. We hope you will take this chance to make new contacts and to exchange ideas for the refinement of primate care and use.

Where further research is needed to develop and validate new refinements, the NC3Rs is keen to support this via its research funding schemes www.nc3rs.org.uk/fundingschemes

Thanks to everyone for your interest and have a great day.

Dr Mark Prescott
Head of Research Management and Communications
NC3Rs

Agenda

09.30 – 10.00	**Registration and refreshments**
10.00 – 10.10	**Welcome** *Professor Verity Brown, University of St Andrews*
	Welfare assessment
10.10 – 10.40	**Can facial expressions be used for pain assessment in macaques?** *Professor Paul Flecknell, Newcastle University*
10.40 – 11.10	**Different cognitive techniques to examine physiology and pathology in marmosets** *Prof. Dr Almuth Einspanier, University of Leipzig*
11.10 – 11.25	**A new interactive web resource on how best to care for common marmosets in captivity** *Professor Hannah M Buchanan-Smith & Dr Claire Watson, University of Stirling*
11.25 – 11.50	**Refreshments and poster viewing**
	Captive management
11.50 – 12.20	**Use of operant conditioning techniques to improve the welfare of laboratory macaques** *Dr Mollie Bloomsmith, Yerkes National Primate Research Center*
12.20 – 12.50	**Laboratory macaques – when to wean?** *Dr Mark Prescott, NC3Rs*
12.50 – 13.50	**Lunch and poster viewing**
	Refining scientific procedures
13.50 – 14.20	**Improving the welfare of non-human primates in a research setting – a veterinarian's perspective** *Mr Jaco Bakker, Biomedical Primate Research Centre*
14.20 – 14.50	**Automated testing of cognitive performance in semi-free-ranging baboons (*Papio papio*)** *Dr Joël Fagot, CNRS and Université de Provence, Marseille*
14.50 – 15.20	**The vacuum helmet method for non-invasive head restraint of macaques** *Dr Martine Meunier, INSERM, CNRS, & Université de Lyon*
15.20 – 15.50	**Transcutaneous signal transmission without breaching the skin's natural barrier to infection** *Professor Stuart Baker, Newcastle University*
15.50 – 16.00	**Discussion, poster prize and closing remarks**
16.00 – 17.00	**Networking reception**

Can facial expressions be used for pain assessment in macaques?

Professor Paul Flecknell, Newcastle University, UK

Our current ability to assess pain in non-human primates is very limited. Similar problems occur in other species of animals, but over the last decade behaviour-based pain assessment systems have been developed for a range of companion, farm and laboratory species. In contrast, there has to date been only one study[1] attempting to develop an ethogram to allow post-operative pain assessment in non-human primates. Recent work in mice[2] has indicated that facial expressions may be a useful means of assessing pain. Given the greater range of facial expressions that can be identified in primates, and the recent development of a facial action coding system for macaques[3], this would seem a potentially useful means of assessing pain.

A pilot study was undertaken in collaboration with our neuroscience research groups at Newcastle, to assess the feasibility of monitoring and recording both facial expression and general behaviour in rhesus macaques. Animals underwent a number of presumed painful and non-painful procedures as a necessary part of on-going research projects. Overall behaviour and facial expressions were recorded before each procedure, after recovery from anaesthetic, and before and after administration of additional analgesics, 24h following surgical procedures.

Preliminary analysis of these data indicated that clear differences in behaviour and facial expression occur following surgical procedures, and that some of these changes have the potential to be developed into a pain scoring system. If successful, this would enable selection of appropriate analgesic regimens, adjustment of these regimens to provide effective pain relief for each individual animal, and contribute objective assessments to the on-going debate on cumulative suffering.

References

1. Allison SO et al. (2007) Assessment of Buprenorphine, Carprofen, and their combination for postoperative analgesia in olive baboons (*Papio anubis*). *Journal of the American Association for Laboratory Animal Science* 46: 24-31

2. Langford DJ et al. (2010) Coding of facial expressions of pain in the laboratory mouse. *Nature Methods* 7: 447-449

3. Parr LA et al. (2010) Brief communication: MaqFACS: A muscle-based facial movement coding system for the rhesus macaque. *American Journal of Physical Anthropology* 143: 625-630

Different cognitive techniques to examine physiology and pathology in marmosets

Prof. Dr Almuth Einspanier, University of Leipzig, Germany

Common marmosets (*Callithrix jacchus*) are the most frequently used New World primates in biomedical research, because of their genetics as well as their physiological and anatomical similarity to humans. Especially in the field of reproductive medicine, they serve as animal models for many human-related diseases, such as endometriosis[1] (EM). However, to date only some test systems are available to evaluate impairment and pain caused by procedures and diseases, followed by assessment of the comfort status of the animal under the therapy.

Diurnal profiles of healthy animals were obtained by videotaping to get information about physiological behaviour throughout the day in captivity. By using videotaping different behavioural skills (e.g. foraging, grooming) can be analysed. For testing mobility and exploratory behaviour, a food tree[2] was designed. The cognitive abilities were examined by Wisconsin General Test Apparatus[3] (WGTA) and a food tree.

Differences in social behaviour and cognitive skills between marmosets with established EM and healthy monkeys were investigated using the videotaping, the WGTA and a food tree. Healthy marmosets showed a mostly trimodal course of activity. Social grooming and activity were significantly decreased in animals with endometriosis, furthermore, the diseased monkeys habituated significantly worse to the cognitive test settings3. The food tree experiments offered no differences between diseased and control animals.

In summary, the videotaping and the WGTA are suitable methods to detect disease (e.g. EM) related impairments in common marmosets, which is essential for the refinement of experiments. In the future, these behavioural tests will be used in pharmacological trials to assess the effect of medical treatments on marmosets with EM, and to refine the experimental procedures.

References

1. Einspanier A et al. (2006) Induction of endometriosis in the marmoset monkey (*Callithrix jacchus*). *Molecular Human Reproduction* 12(5): 291-299

2. Arnold C et al. (2011) Behavioral tests as indicator for pain and distress in a primate endometriosis model. *Journal of Medical Primatology* 40: 317-326

3. Harlow HF (1949) The formation of learning sets. *Psychological Review* 56: 51–65

A new interactive web resource on how best to care for common marmosets in captivity

Professor Hannah M Buchanan-Smith and Dr Claire Watson, University of Stirling, UK

Common marmosets (*Callithrix jacchus*) are probably the most frequently privately kept non-human primate, and are the most used New World primate in laboratory research and testing in the UK. Understanding and being able to assess their welfare state is essential for both ethical reasons and for quality of scientific output, and is critical to assess the efficacy of planned Refinements to housing, husbandry and procedures for marmosets in laboratories. At this meeting we describe an interactive, open access website that aims to promote marmoset welfare worldwide. The website provides easily accessible information on how best to care for marmosets in captivity for private owners, zoo and laboratory professionals. This comprehensive and visually appealing website includes a modern, multimedia update of the 'ethogram', with descriptions, images and video of common marmoset calls, behaviours, postures, facial expressions along with welfare interpretation. Videos illustrate practical examples of implemented enrichment and highlight the welfare benefit of encouraging natural behaviour. Captivating images show how marmosets in the wild spend their day. The site provides information on social factors, housing, feeding, health, interaction with human caregivers, handling and training. Links direct site visitors to more detailed information. Whilst giving advice, the website strongly discourages the private ownership of marmosets, outlining persuasive reasons. Funding for the creation of this website was generously provided by the National Centre for the Replacement, Refinement and Reduction of Animals in Research (NC3Rs) and by the Primate Society of Great Britain's Captive Care Working Party.

Use of operant conditioning techniques to improve the welfare of laboratory macaques

Dr Mollie Bloomsmith, Yerkes National Primate Research Center, USA

Positive reinforcement training relies on teaching animals to cooperate with behaviors we would like them to engage in, without any use of force or coercion. This type of training is becoming a very important tool in managing captive primates. Positive reinforcement training can promote the welfare of primates by reducing stress associated with research or husbandry procedures, and by increasing cognitive stimulation, physical activity, and opportunities for choice and control. This presentation will briefly describe what can be accomplished with positive reinforcement training of laboratory primates, and then will provide more detail on applying this technique to two different types of behavioral problems: fearful behavior and abnormal behavior. The training technique of desensitization can be applied to reduce fearful behaviors. A study conducted at the Yerkes Primate Center with rhesus macaque subjects who were fearful of some husbandry procedures, found improvements in their behavior following six weeks of desensitization training. Further application of this approach is now being applied to additional primates at Yerkes. Other studies indicate that positive reinforcement training can reduce abnormal behaviors (such as stereotyped behavior) when a trainer is working directly with the animals, but there are contradictory findings concerning whether such a change generalizes to times outside of when the trainer is present. Training of incompatible behaviors may also have promise in reducing abnormal behavior through this technique. Positive reinforcement training has broad utility to improve the welfare of laboratory primates.

Laboratory macaques – when to wean?

Dr Mark Prescott, NC3Rs, UK

Worldwide there is large variation in the age at which young macaques destined for use in research and testing are permanently separated from their mothers, and in the subsequent social environment in which they are reared. This stems from variation in minimum weaning ages and rearing practices in guidelines on laboratory animal care and use, as well as from scientific, business and other considerations. In this presentation I summarise the literature on the effects of weaning policy on the behavioural and physical development of macaques, and present production data from breeding colonies of rhesus and long-tailed macaques. The aim is to help guide decision-making on weaning policy to improve animal welfare and quality of science. On the basis of the evidence presented, unless there is strong justification for artificial weaning on scientific or animal health grounds, it is preferable for young macaques to remain with their mothers until they have become behaviourally independent. Minimum weaning age should therefore not normally be less than 10-14 months old, but weight, health and behavioural criteria should be used to determine the most appropriate weaning age for the welfare of each individual monkey.

References

1. Prescott MJ et al. (2011) Laboratory macaques: when to wean? *Applied Animal Behaviour Science* (in press)

Improving the welfare of non-human primates in a research setting – a veterinarian's perspective

Mr Jaco Bakker DVM, Biomedical Primate Research Centre, The Netherlands

The Biomedical Primate Research Centre (BPRC) is committed to using non-human primates for performing biomedical research on serious human life-threatening diseases with primates as a model, only when there are no alternatives. Research is also required to identify and develop alternatives to the use of non-human primates. Therefore the BPRC has an active and expanding programme to develop alternatives following the principles of reduction, refinement and replacement.

Over the past few years, animal housing conditions have changed considerably as new European and Dutch guidelines for animal care and welfare have been introduced. The BPRC has responded to these guidelines in a timely manner, leading to major improvements in the animals' welfare. Outside enclosures, the use of deep litter as bedding material, and the fact that disinfectant agents are no longer used in enclosures, are initiatives that distinguish the BPRC from other centres. Training the animals has reduced the potential stress associated with both routine husbandry as well as experimental studies. Staff training has enhanced knowledge and led progressively to optimisation of marmoset keeping and breeding.

Knowledge of primate medicine has increased considerably over the past years, although a lot is still to be discovered, especially in the field of welfare. We are continuously trying to achieve better circumstances in which to keep our primates. A unique opportunity arises for further research in marmoset medicine, management, care and welfare, leading to better animal health. Several of the above mentioned research areas will be discussed in this presentation.

Automated testing of cognitive performance in semi-free-ranging baboons (*Papio papio*)

Dr Joël Fagot, CNRS and Université de Provence, France

Laboratory procedures used to study the cognitive functions of primates traditionally have involved removal of the subjects from their living quarters to be tested singly in a remote experimental room. I will present an alternative research strategy favouring testing primates while they are maintained in their social group. Our approach uses a new automatic learning device, called ALDM, which has been developed in my laboratory to study primate cognition. This computerized test system is controlled by an automatic radio frequency identification of subjects. During the last 3 years, we provided a battery of 10 ALDM *ad libitum* inside a large social group of 30 baboons, for voluntary self-testing on a 24h schedule. ALDM test systems have been used to assess cognitive performance in tasks aimed to study motor control, short term memory, perception and complex reasoning. I will present the main features and functionalities of the ADLM test system, summarize some of our findings, and demonstrate that this approach favours high trial frequencies[1] and excellent learning performance[2], even in tasks involving the highest cognitive complexities[3]. This approach can potentially be transferred to other domains of sciences, neurosciences in particular, to improve animal welfare in experimental research.

References

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2. Fagot J & Bonté E (2010) Automated testing of cognitive performance in monkeys: Use of a battery of computerized test systems by a troop of semi-free ranging baboons. *Behavioral Research Methods* 42, 507-516

The vacuum helmet method for non-invasive head restraint of macaques

Dr Martine Meunier, INSERM, CNRS & Université de Lyon, France

Studies in the awake macaque very often rely on techniques that require holding the monkey's head motionless. This is true for classical neurophysiological recording procedures, remote eye-tracking devices, and also for functional magnetic resonance imaging (fMRI), a technique that is increasingly used in the awake macaque. Up to now, a surgically implanted head post was the only available means to restrain monkey's head movements. Head posts minimize head movements in a highly reliable way and decades of practice over the World have perfected associated perioperative care. They nevertheless present two possible drawbacks. They sometimes lead to surgical complications and, for imaging, even plastic posts and screws can distort the fMRI signal. Over the last two years, we initiated a protracted research program seeking to elucidate the physiopathology of hemi-neglect and to improve treatments of this very frequent and invalidating disorder. The program is to be unfolded in two phases. For the first one, remote eye tracking and fMRI suffice; only as a second step are invasive fMRI-guided muscimol injections needed. We therefore sought an alternative head restraint method that would allow us to complete the initial phase of our project without resorting to surgical implants. A single alternative was available in the literature, proposed in 2010 by Srihasam et al.[1] These authors described, for the first time, an alternative head restraint method, the "vacuum helmet", which consists of a custom-fitted plastic helmet maintained by a chin strap and mild suction supplied by a vacuum blower. In the present talk, we will describe how we conceived another version of the vacuum helmet, together with a small French company specialized in stereo-lithography, and what progress we have made over the last few months while testing it.

References

1. Srihasam K et al. (2010) Noninvasive functional MRI in alert monkeys. *NeuroImage* 51: 267–273

Transcutaneous signal transmission without breaching the skin's natural barrier to infection

Professor Stuart Baker, Newcastle University, UK

Our current neurophysiological experiments in behaving monkeys implant electrodes to record electromyogram (EMG) from the arm and hand. Wires from these electrodes pass sub-cutaneously to a connector on the head. The electrodes yield stable, high quality recordings. However, the permanently open wound around the connector often becomes infected, impairing the welfare of the animal and reducing data quality.

To solve this problem, we are developing a novel telemeter. Wires from 16 EMG electrodes pass under the skin to a transmitter implanted on the back. This amplifies and digitises the signals, and then transmits the data out wirelessly. The entire implant surgery is carried out under high standards of asepsis, and prophylactic antibiotics are given in the post-operative period. Under these conditions, the implant can be kept free of infection, since there is no skin opening through which infection can enter.

Although telemetry systems are in widespread usage in other fields, the particular requirements of our application made the development of this system a challenging engineering problem. EMG signals are rapidly changing, requiring that they be digitised at a high sampling rate of 5 kSamples/s to capture all features. With 16 channels, and 12 bits/sample, this requires a transmission bandwidth of nearly 1 Mbit/s. Amplification of so many channels is also a challenge within the confines of an implanted circuit. Finally, the device must operate for ~5 hours per day, 5 days per week, for up to 1 year. No current battery technology can provide even a fraction of this lifetime, given the high power requirements of transmission of these data bandwidths.

Our solution uses two circuit boards, each encapsulated in medical silicone. One receives power by inductive coupling from an external power coil, and contains regulator circuitry – this obviates the need for a battery. A constant-voltage DC supply is then fed to a second circuit board over implant-grade cables. The second board amplifies the EMG signals, digitises them, and transmits the data over a 403.5 MHz digital radio link. The system operates at a data rate of 1.6 Mbits/s, allowing framing and limited error detection and correction. The use of two physically separated circuit boards prevents noise generated by the interaction of the high-energy power field with the low level EMG signals prior to amplification. An external receiver placed near the animal decodes the radio signal, and outputs 16 analogue waveforms corresponding to amplified and filtered EMGs. This allows straightforward connection to a wide range of standard data acquisition hardware.

An initial prototype of the telemeter was implanted in a macaque monkey undergoing experiments in the laboratory. The device integrated well with the tissue, and after 3 months there was no sign of infection or tissue rejection. It powered up, and successfully transmitted data. However, a problem with the function of the front-end amplifier prevented the signals from being of practical use, and the system had to be explanted. With further funding from NC3Rs, we are now producing a further iteration of this system, which will solve the amplifier problems. We will implant the device into a macaque monkey as part of our ongoing experiments in movement control, providing in vivo performance data. Following successful tests, we will then make this design available to other groups worldwide.

Although initially designed to measure EMG, our telemeter is equally suited to other high-bandwidth signals. Configuration is achieved via a Field Programmable Gate Array (FPGA). This means that we can easily reassign bandwidth between channels without circuit redesign. For example, we could record four channels at 20 kSamples/s, which would be suitable for neuronal action potential recordings.

We consider that repeated infections associated with the transcutaneous connector currently represent the major welfare cost to monkeys both in our experiments and those of similar groups around the world. Eliminating these infections would be a considerable refinement of technique. In addition, such infections can reduce the quality of behavioural data which is obtained, due to the clinical malaise suffered by the animal. This limits the science which can be achieved (i.e. new knowledge discovered) per animal used. Finally, severe infections may cause an experiment to be terminated prematurely, before sufficient data has been gathered. This would require the use of a further animal to complete the project. The proposed solution can therefore also achieve a reduction in animal numbers.

This work is supported by two NC3Rs project grants: G0600338 and G1100550

Poster abstracts

Poster 1

Refinement of rearing practices in the common marmoset (*Callithrix jacchus*)

Miss Hayley Ash, University of Stirling, UK

The common marmoset is the most frequently used New World primate in scientific research and testing, with 1,103 procedures performed on 674 marmosets in the UK in 2010. A considerable number is also housed in the UK for breeding. However, there are problems associated with their breeding, including high infant mortality, how to deal with "excess" infants, and low dam reproductive lifespan. Although the average litter size in captive colonies has increased from two infants in the 1970s and 1980s to three infants since the 1990s, marmoset families are rarely able to rear more than two infants without some form of human intervention. This hand-rearing necessitates long-term parental separation, which is known to have adverse developmental consequences. As the behaviour and physiology of early deprived marmosets differs from that of controls, early rearing history may not only affect welfare, but also lead to unwanted variability in scientific output, thus increasing the number of animals required.

The current study will follow individuals throughout early life, linking a battery of behavioural, physical, physiological and cognitive measures of welfare, to identify systematic differences in marmosets of different rearing backgrounds. Back-record analysis will also be conducted, to identify factors affecting litter size and dam survival. If as hypothesised, marmoset infants from twin litters have the highest welfare, lowest mortality and produce the best research models, studies will investigate how to maximise twin births. When litters do exceed two, evidence-based recommendations for the Refinement of rearing practices will be developed to minimise adverse welfare effects in breeding facilities, as well as Reduce the numbers used in laboratories by ensuring that they are fit for purpose.

This work is supported by an NC3Rs studentship: Buchanan-Smith.H.11-07-2009

Poster 2

Refining the use of red-bellied tamarins: genetic management of breeding colonies and definition of the impact of MHC polymorphism on infection dynamics

Poster 3

Refinement of the macaque model of human tuberculosis through characterisation of the rhesus and cynomolgus macaque species

Dr Sally Sharpe, Health Protection Agency, UK

Introduction

Tuberculosis (TB) is a re-emerging disease. There is an urgent need for a more effective TB vaccine, as the current vaccine, BCG, is neither effective in all age groups, nor in all countries (especially those where the burden of TB is greatest). Non-human primates potentially represent the most relevant system to predict safety, immunogenicity and protective efficacy of vaccines prior to their introduction in humans.

Plan

This study sought to characterise and compare three macaque species of different genetic origin: Indian rhesus, Chinese cynomolgus and Mauritian cynomolgus as models of human tuberculosis in terms of their similarity to humans in the response to BCG vaccination and their susceptibility to infection with *M. tuberculosis*.

Results

IFNγ responses induced in rhesus macaques following BCG vaccination more closely resemble the responses induced in UK human volunteers than responses in cynomolgus macaque species. Inherent differences were identified between the three macaque species in the levels of different cell populations in the periphery prior to vaccination or infection. Susceptibility to aerosol infection with *M. tuberculosis* was found to vary among macaques: rhesus macaques were found to be more susceptible to tuberculosis than Chinese cynomolgus macaques, but less susceptible than Mauritian cynomolgus macaques.

Welfare

Understanding the underlying factors responsible for the differences between the non human primate species will be critical to the selection of appropriate models for intervention evaluation. Use of the most relevant models for the evaluation of interventions will not only refine each study performed but will ultimately reduce the number of animals required.

Poster 4

Refining rhesus macaque models of human disease by genetic management of the HPA colony

Miss Shmona Simpson, Health Protection Agency, UK

Introduction

The HPA manages a rhesus macaque breeding colony situated on the Porton Down site. Rhesus macaques of Indian origin form an essential component of HPA research programmes. Their reproducible susceptibility to pathogens such as *Mycobacterium tuberculosis* and simian immunodeficiency virus (SIV) forms the cornerstone of work to develop and evaluate novel vaccines and therapies. Their biological similarity to man has allowed demonstration of immunogenicity, safety and efficacy of products that are near to clinical use or in early-phase clinical trials. For agents where human trials are impracticable, data from macaque models are vital in supporting regulatory submissions for drug registration. There is an increasing body of evidence indicating that MHC type affects susceptibility to disease and immune responses to vaccination.

Plan

We aimed to determine the prevalence of ten important MHC alleles in the colony (Mamu-A*01,

-A*02, -A*08, -A*11, -B*01, -B*03, B*04, B*08, -B*17, -B*29) with a recognised role in pathogen susceptibility, using sequence specific primer-PCR, to establish a genetics-led breeding programme to prevent loss of key alleles from the population. Work is also in progress to define relationships between MHC alleles and susceptibility SIV and *M. tuberculosis* in studies using the rhesus models at the HPA.

Results

MHC types of all breeding animals have been defined. Juvenile animals have been identified for a new breeding group based on their genetics to preserve the currently identified alleles in the colony and increase the prevalence of less frequently found alleles.

Welfare

Selection of animals with the most relevant MHC alleles for studies will reduce the number of animals required to provide statistically significant outcomes and refine studies by eliminating the unnecessary use of less relevant macaques. Genetics-led scientific management will be a major enhancement of the HPA rhesus macaque breeding colony as it will ensure long-term supply of MHC-defined animals.

Poster 5

EUPRIM-Net: ensuring best practice and advancing the 3Rs in primate research

Dr Björg Pauling, German Primate Center (DPZ), Germany

Now and for the foreseeable future non-human primates (NHPs) will play an irreplaceable role in biological and biomedical research where their use can be sufficiently justified and no alternatives exist. Although only 0.1% of all animals used in basic or applied research are NHP, their high sensory and cognitive abilities necessitate that research with NHP is subject to particularly high ethical (and legal) standards and a careful application of the 3Rs concept of Refinement, Reduction, Replacement must be imperative.

The European Union and its national states have instituted a large number of measures to ensure the best welfare of NHP used for scientific purposes. Besides legislative and regulatory efforts, the European Commission has provided funding to EUPRIM-Net, a network of nine European primate centres from six countries which was established as a Research Infrastructure in 2006 and has recently been granted a second round of funding of seven million Euros until 2014.

Under this project, the primate centres' infrastructures and expertises are integrated to provide critical services, training and advice to scientific institutions in Europe conducting primate research and to zoological gardens keeping primates. The activities are divided into Network-, Access- and Research Activities all aimed at promoting animal welfare and the 3Rs. Furthermore, since the beginning of this year, the project is actively developing ties to the industry and primate centres outside EU borders.

Directive 2010/63/EC foresees various animal protection and welfare measures reflected in EUPRIM-Net's activities. The Network Activities are about Education and Training, Best Practice and Veterinary Care, as well as Positive Reinforcement Training and Animal Behavioural Management. These activities are supported by Research Activities on Diagnostics and Diseases, Telemetry, and Alternative Methods. Moreover, EUPRIM-Net offers a BioBank for access to primate material. EUPRIM-Net thus contributes to improving the 3Rs in and outside Europe.

Poster 6

The EUPRIM-Net course series: upgrading personnel to support animal welfare

Dr Thomas Ziegler, German Primate Center (DPZ), Germany

Non-human primates play an important role in biological and biomedical research. The EU-funded European Primate Network (EUPRIM-Net) brings together nine European primate centres and is aimed at advancing knowledge and competence in biological and biomedical research, animal keeping and breeding. For housing of primates and studies with primates it is essential to consider the principles of good scientific practice and animal welfare. Hence, all personnel involved in primate research are required to have a good understanding of primate biology, to ensure that animals receive adequate care under appropriate keeping conditions. Accordant conventions have been formulated by the Council of Europe[1] and the Federation of European Laboratory Animal Science Associations (FELASA) has developed recommendations along these lines[2,3]. However, existing knowledge and expertise are often widely dispersed. In an effort to pool essential knowledge and to disseminate it to the different groups of people working with primates, EUPRIM-Net has developed a series of courses for a broad international audience, mainly scientists, veterinarians, colony managers and students. Additional courses are addressed specifically to animal caretakers and technical staff. The intention of the EUPRIM-Net course series is to spread sound knowledge and latest developments quickly across Europe to support science that meets the highest ethical standards for primate-based animal research. Accordingly, EUPRIM-Net courses cover a great variety of topics, related to the wellbeing of primates in captivity, including their general biology, behaviour, husbandry, medical aspects, environmental enrichment and ethics. In addition, course participants can improve their interpersonal skills to communicate state of the art primate based research. The poster gives an overview of the concept of the EUPRIM-Net course series, its contents and target audiences. We aspire to official accreditation of the course series. Detailed information on upcoming EUPRIM-Net courses can be found at: www.euprim-net.eu/network/courses.htm

References

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2. FELASA (1995) FELASA recommendations on the education and training of persons working with laboratory animals: Categories A and C. *Laboratory Animals* 29, 121-131

3. FELASA (1999) FELASA guidelines for the education of specialists in laboratory animal science (Category D). *Laboratory Animals* 33, 1-15.

Poster 7

External telemetry significantly improves ECG assessment in non-human primates over standard methods

Dr Matthew Skinner, AstraZeneca, UK

External telemetry for ECG (electrocardiogram) assessment in dog toxicology studies has proven to be more sensitive than the historical restrained 'snapshot' recordings[1,2]. Similar methodology is also available for non-human primates (NHPs) but data quality has not yet been formally assessed comparing telemetered with restrained animals.

Baseline heart rates (HR) extracted from 20 regulatory studies (mean ± SD) were much higher in restrained NHPs (RES: 236 ± 29 bpm, n=447) than in freely moving telemetered NHPs (TEL: 155 ± 29 bpm, n=222). There was no difference between invasive implanted (154 ± 29 bpm, n=147) and external telemetry (158 ± 30 bpm, n=75), demonstrating that stress-free conditions can be achieved by training NHPs to wearing jackets, but not to restraint.

Detection of a significant tachycardia ($p<0.05$, 80% power, n=6) using RES would require a group mean value of 283 bpm. This was never achieved in the 27 studies reviewed using RES, compared to a 17% incidence detected using invasive telemetry (23 studies). A similar comparison gives a better picture for dogs, with 22 vs. 44% incidence in RES compared to telemetry (230 and 211 studies respectively).

Whilst part of the difference between dogs and NHPs could be due to species sensitivity, the use of RES is likely to affect the relevance of ECG recordings in NHPs. The use of external telemetry in NHPs would simultaneously improve animal welfare and decrease the risk of 'false negatives', in addition to providing a relevant amount of data for individual QTc correction and arrhythmia review when relevant.

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