Comparative Vertebrate Nociception and Pain  (3-Dec-2002)

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The main research area of my group is in comparative vertebrate nociception and pain primarily in birds and fish. Previous to our work nothing was known about nociception or pain in bony fish and the evidence from elasmobranch fish has questioned its existence. It has been suggested that in a marine aquatic environment a well-developed system for perceiving nociception and pain may be of little adaptive value and perceiving the threat of injury is more important. To investigate nociception and pain in bony fish an electrophysiological study was undertaken to try and identify cutaneous nociceptors. The behavioural and physiological responses to noxious cutaneous stimulation were also investigated. Cutaneous polymodal nociceptors were physiologically characterised by recording from single afferent fibres in the trigeminal ganglion. These nociceptors responded to mechanical, thermal and chemical stimulation but unlike higher vertebrates there were very few C-fibres in the peripheral nervous system in the fish and A-delta fibres predominated. Administration of algogenic agents (bee venom) to the lips of the trout affected both the physiology and behaviour of the animal. Respiration was significantly increased as shown by a substantial and prolonged increase in opercular beat rate. Fish injected with venom also performed a characteristic "rocking" behaviour. It is clear that bony fish have a well developed nociceptive system which is very relevant to the evolution of vertebrate nociception as well as prompting the question, do fish perceive pain?

The major part of the work programme however is concerned with understanding peripheral neural mechanism of nociception in avian health and disease. By electrophysiological recordings from single afferent fibres we have identified and determined the response characteristic of nociceptors in the beak, feet and joint capsule. The work on the chicken beak was concerned with neuroma formation following partial amputation and the investigation of post-amputation stump pain. The work on the joint capsule was extended to investigate arthritic pain arising from the ankle joint. The physiological responses of single joint capsule nociceptors has be characterised during different arthritic diseases. To compare avian studies adjuvant arthritis was investigated and the work has been extended to investigate more natural disease states such as Gout (sodium urate arthritis) and mycoplasma arthritis. Sodium urate arthritis has been used in a number of experiments to investigate endogenous analgesia and the importance of attentional mechanisms in pain perception in birds. The prolonged pain-related behavioural changes following the induction of sodium urate arthritis has also been used to determine protocols for the use of local anaesthetics to alleviate arthritis. Sodium urate arthritis has been used in a number of experiments to investigate endogenous analgesia and the importance of attentional mechanisms in pain perception in birds. The prolonged pain-related behavioural changes following the induction of sodium urate arthritis has also been used to determine protocols for the use of local anaesthetics to alleviate arthritis. Sodium urate arthritis has been used in a number of experiments to investigate endogenous analgesia and the importance of attentional mechanisms in pain perception in birds. The prolonged pain-related behavioural changes following the induction of sodium urate arthritis has also been used to determine protocols for the use of local anaesthetics to alleviate arthritis. Sodium urate arthritis has been used in a number of experiments to investigate endogenous analgesia and the importance of attentional mechanisms in pain perception in birds. The prolonged pain-related behavioural changes following the induction of sodium urate arthritis has also been used to determine protocols for the use of local anaesthetics to alleviate arthritis.

Flunixin at doses that were effective at suppressing pain-related behaviour in sodium urate arthritis did not effect the gait of lame broilers. It seems therefore that the abnormal gaits shown by the majority of heavy broiler chickens is a result of biomechanical difficulties arising from the changed body confirmation rather than being pain related.

Commercial poultry are often subjected to environmental pollution with noxious gases such as ammonia in poultry sheds and carbon dioxide during gaseous killing. To investigate the possible noxious consequences of these gases we are currently undertaking a series of studies to physiologically characterise the responses of single nasal nociceptors to different levels of gaseous stimulation. Extracellular recordings from sensory afferents in the trigeminal ganglion have identified polymodal nociceptors in the nasal epithelium responding to both mechanical and chemical stimulation. Because of the complex folding...
of the lining in the nasal cavity it has not been possible to investigate thermal sensitivity. Thresholds to stimulation with ammonia have been established as well as stimulus response curves to different concentrations. This work is currently being extended to investigate carbon dioxide.

In addition to developing skeletal problems the genetic selection for increased muscle mass has predisposed the meat type chicken towards idiopathic and stress-induced myopathies. We have just started a series of experiments to investigate muscle pain by investigating the biochemical and histomorphological features of skeletal muscle as well as the physiological properties of muscle nociceptors.

In future we are hoping to secure funding to investigate the pain resulting from bone fracture. Bone breakage is common in avian species utilised in commercial farming systems especially hens kept for egg production which suffer significant osteoporosis with the resultant fractures. The major animal welfare considerations of fracture are its possible painful consequences, probability and effectiveness of repair and resulting disability. It will also allow a detailed investigation of the effect of fracture and repair on peripheral neural afferents.

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