CONDUCTING MOLECULAR-GENETIC RESEARCH IN ANIMALS AND ITS PROMISING RESULTS

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ABSTRACT

This article presents the history of molecular genetic research and its current use and achievements. The analysis of molecular-genetic processes in animals was explained.

Key words: *animal, research, laboratory, gene, molecular, clinical, tissue*

Animal models have been an important research and learning tool for millennia and are becoming even more important with the advent of the molecular genomic revolution. Although the role of molecular genomics in laboratory research and clinical practice is increasingly recognized, the relevance of preclinical studies to laboratory practice is not always clear. However, several published articles have addressed the relevance of these areas of study to nurses working in research and clinical practice. A similar situation prevails in the broader community of health sciences researchers: the role of nurses in various aspects of preclinical research and subsequent translation efforts is often not recognized or underestimated. Thus, in 2,500 years of documented animal research, nurses make up only a small fraction of the scientists doing such work. This can be partly explained by the relatively new nature of the laboratory profession and the new role of nurses as scientific researchers. Given that nurses are primarily concerned with their patients, many nurse scientists prefer to use samples taken directly from the target population. In addition to their direct role in conducting research, nurses are also indirectly involved in preclinical research. Nurses interested in promoting the welfare of laboratory animals may volunteer their time to serve on a research council

such as the University Animal Care and Use Committee (IACUC). The variety of tools through which clinical nurses can contribute to animal research for their own learning and professional development, as well as leadership and service experience that can be demonstrated in a resume or curriculum vitae, creates opportunities.

First study found evidence for paravascular fluid circulation in the central nervous system (CNS). In this study, the researchers used microscopic examination of the brain tissue of cats and dogs after injections of tracers; control over the timing of sample collection (between two minutes and four hours after this tracer injection) allowed temporary investigation into ethical or unlikely events in humans. Although the circulation of paravascular fluid in humans has not been studied, this action has clear clinical implications. First, he showed that solutes in the cerebrospinal fluid rapidly enter the extracellular space (ECS) via microvascular pathways; prior to this study, fluid exchange was erroneously thought to occur solely by diffusion. The authors also acknowledge that this work suggests ways to limit paravascular solute flow by reducing or completely suppressing the pulsation (eg, partial ligation of the brachiocephalic artery) (eg, if this leads to adverse effects in the pacemaker). A second study by the three investigators of the original study further expanded our understanding of the paravascular circulation. This follow-up study examined the effect of edema on paravascular transport reported previously. Cats were subjected to a cold lesion pattern leading to vasogenic edema and an indicator was administered to monitor paravascular circulation. Paravascular transport was significantly reduced in the edematous areas, indicating a rarefied tracer level in the edematous areas. Since edema is characteristic of many CNS diseases such as traumatic brain injury, stroke, meningitis, and encephalitis, this line of research has the potential to have wide clinical applications. The results of these preclinical studies indicate that exposure to endotoxin results in downstream endocrine signaling pathways such as insulin, somatostatin, lactate, and pituitary hormones. Since these studies have been done, the relationship between endotoxin and hormones has been further supported by human studies conducted by non-nurses.

In the genomic era, animal models are commonly used in conjunction with molecular and genomic research methods. Other studies are investigating the effects of indirect genes using experimental animals that have undergone genome modification in one or more ways. There are many examples of nurses contributing to molecular genetic research using animal models. Several notable examples are discussed below. The identification of genes associated with various diseases is an important area of research to which nurses contribute. One study used genome-wide screening in mice and identified a new gene (Gan1) associated with antiretroviral therapy-associated peripheral neuropathy. One implication is that targeting Gan1 or its protein can reverse neuropathy in people taking antiretrovirals. In addition, we report genetic variation in the form of frameshifts and nonsense mutations for Gan1, which may be relevant to precision medicine initiatives to determine the best therapeutic regimens for patients with neuropathy. Another study exploited the ability of researchers to use molecular techniques without controversy to create mice with a specific gene removed from the genome, a so-called gene knockout (KO). In this mouse model, knockout of the TrkB.T1 receptor was associated with improved outcomes, including preservation of hippocampal neurons. A follow-up study using the same strain of mice showed that TrkB.T1 receptor knockout was associated with changes in sleep, including increased time spent in REM sleep and decreased sleep duration. This information may be relevant for the specific treatment of individuals with certain genotypes associated with sleep disorders.

Changes in gene expression in the context of various conditions have also been studied by several nurse researchers. For example, FOS gene expression occurs in some infectious diseases and endotoxemia. Another study showed that non-coma hypoglycemia in a rat model was associated with decreased levels of neuropeptide Y mRNA and pro-opiomelanocortin. The above research may also lead to precision medicine initiatives. For example, some patients may benefit from antisense therapy, which binds to overexpressed mRNA so it cannot convert it to protein.

Another study evaluated the effect of 60-minute inspiratory resistance exercise (vs. sham) on gene expression of twenty-seven known apoptotic proteins in dopamine- or saline-treated rats. Twelve proteins were expressed in the diaphragm, two of which showed higher expression after inspiratory resistance exercise with dopamine treatment (saline control). In particular, levels of copper-zinc superoxide dismutase (SOD [CuZn]) and event-related proprioceptive potential (PERP) were elevated, suggesting that dopamine reduces the apoptotic consequences of this condition.

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