

# Swine in Biomedical Research: Management and Models

M. Michael Swindle, Alison C. Smith, Kathy Laber-Laird, and Laurel Dungan

### INTRODUCTION

For the last 2 decades, swine have been used with increasing frequency in biomedical research as replacements for dogs and primates, as well as models of human disease based upon their own unique anatomy and physiology (Stanton and Mersmann, 1986; Swindle, 1992; Tumbleson, 1986).

All of the domestic farm breeds and miniature breeds available in the United States are *Sus scrofa domestica*. Farm breeds have the disadvantage of a rapid growth rate, increasing from an average weight of 1 kg at birth to 100 kg at 4 months of age. Mature brooding stock typically reach weights of greater than 200 kg. Consequently, these animals are best used for non-survival or short-term projects of less than 3 weeks in duration.

Miniature pigs are more commonly used for long-term projects because of their smaller size and growth rate. Depending on the breed, miniature pigs grow from a birth weight of 0.5 kg to 12-45 kg, at 4 months of age. Breeding stock reach weights of 45-100 kg. Commercially available miniature pigs also tend to be more tractable than domestic breeds raised in an agricultural setting. The most commonly used laboratory breeds of miniature pigs are Yucatan miniature, Yucatan Micropig®, Hanford, Sinclair (Hormel), Pitman-Moore, and Goettingen (Panepinto, 1986).

The purpose of this article is to review the use of swine in biomedical research and to provide general information on the husbandry and management of the various breeds in a laboratory setting. If an institution seeks to raise swine in large numbers, it would be well advised to consult an agricultural scientist involved in swine production programs for advice on facility design and management.

### BIOMEDICAL MODELS

Swine are commonly used in cardiovascular research because swine and humans share important anatomic and physiologic characteristics. Their hearts are approximately

the same size, and coronary blood flow, hemodynamic and myocardial contractility, development of atherosclerosis are analogous (Stanton and Mersmann, 1986). Consequently, swine are used to study congenital heart disease (Gillette et al., 1991; Mitchell et al., 1994; Swindle et al., 1992), myocardial infarction (Bloor et al., 1992), hemodynamics and shock (Hansson, 1992; Hoban et al., 1992), development of interventional radiology devices including balloon catheters and intravascular stents (Gal and Isner, 1992; White et al., 1992), hypertension (Zambraski et al., 1992), cardiopulmonary bypass and anesthesia (Cameron et al., 1992; Weiskopf et al., 1992), heart failure (Hendrick et al., 1990), and atherosclerosis (Lee et al., 1986).

Swine are also used extensively for nutritional studies because their digestive physiology is similar to humans. Because they are omnivores, swine will readily consume a variety of nutritional supplements and test substances (Swindle et al., 1988). They have also been used for many other studies related to nutrition, including total parenteral nutrition, lipid metabolism, diabetes, alcoholism, gastric ulceration, and splanchnic blood flow (Cohen et al., 1992; Laber-Laird et al., 1992; Tumbleson, 1986).

Organ transplantation studies have been performed using the swine heart (Hall et al., 1986), liver (Flye, 1992), kidney (Pennington, 1992), pancreas (Koyama et al., 1986), and intestine (Pritchard et al., 1986). Many of these organ transplantation studies have been related to immunologic aspects of transplants, including the development of transgenic animals that would be immunologically accepted by humans (Sachs, 1992).

Other studies have involved wound healing and plastic and reconstructive surgery (Kerrigan et al., 1986), fetal surgery (Randall, 1986), and pharmacology and toxicology (Kurihara-Bergstrom et al., 1986; Feletou and Teisseire, 1992). Reproductive physiology and endocrine functions have also been studied (Tumbleson, 1986).

Swine are used extensively in surgical training classes for health care practitioners. Initially they were used to train medical students and residents in surgical skills (Swindle and Bobbie, 1983) but are now used extensively to train graduate physicians, nurses, and technical staff in endoscopic and stapling surgical techniques, laser surgery, and microsurgery.

When comparing studies using swine, the differences in physiology, genotype, and phenotype and in maturity at a

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M. Michael Swindle, D.V.M., is Professor and Chairman, Alison C. Smith, D.V.M., is an Assistant Professor, Kathy Laber-Laird, D.V.M., M.S., is an Assistant Professor, and Laurel Dungan, D.V.M., is a resident at the Department of Comparative Medicine, Medical University of South Carolina, Charleston, South Carolina.

# Swine As Models In Biomedical Research

**Kathleen Armour**



## **Swine As Models In Biomedical Research:**

Animal Models in Biomedical Research Cynthia Petrie Smith,1991      Swine as Models in Biomedical Research M. Michael Swindle,Donald C. Moody, Lucy D. Phillips,1992 Swine as Models in Biomedical Research is based on the proceedings of the Seventh Charles River International Symposium which called upon recognised experts in the use of swine as animal models in various biomedical fields to present overview talks in their areas of interest They provide thorough coverage of the use of swine as animal models including immunology organ transplantation neonatology renal failure hypertension anaesthesiology cardiopulmonary bypass cardiovascular pharmacology atherosclerosis interventional radiology myocardial infarction congenital heart disease shock and wound healing Their writing also reflects the increased interest by biomedical researchers in the use of miniature pigs and micropigs instead of commercial farm breeds in the laboratory Of value both to established investigators familiar with swine as well as to junior investigators who are starting their careers of who are unfamiliar with the species this book will be useful to laboratory researchers as well as to veterinarians and technical personnel involved with service functions related to research projects using swine      Animal Models in Biomedical Research Cynthia Petrie Smith,1991      Animal Models in Biomedical Research ,19??      **Animal Models in Biomedical Research** Cynthia P. Smith,1994-07-01 Swine have been utilized as a biomedical research model in a wide variety of disciplines the most notable being cardiovascular research The pig has been used as a model for diabetes alcoholism peptic ulcers and even transplant studies This bibliography is a sampling of the current literature and contains 556 bibliographic citations of articles and books obtained from a variety of scientific and agricultural sources dating from January 1980 to September 1990 Arranged by subject Author index      Swine as Models in Biomedical Research: Proceedings of the 7th Charles River International Symposium, Danvers, Mass., September 18-20, 1989 Charles River International Symposium,1992      **Swine in the Laboratory** M. Michael Swindle,2007-03-22 To diminish the learning curve associated with using swine as models Swine in the Laboratory Surgery Anesthesia Imaging and Experimental Techniques Second Edition provides practical technical information for the use of swine in biomedical research The book focuses on models produced by surgical and other invasive procedures supplying the ba      **The Clinical Chemistry of Laboratory Animals** David M. Kurtz,Gregory S. Travlos,2017-10-18 Key features Serves as the detailed authoritative source of the clinical chemistry of the most commonly used laboratory animals Includes detailed chapters dedicated to descriptions of clinical chemistry related topics specific to each laboratory species as well as organ class specific chapters Presents information regarding evaluation and interpretation of a variety of individual clinical chemistry end points Concludes with detailed chapters dedicated to descriptions of statistical analyses and biomarker development of clinical chemistry related topics Provides extensive reference lists at the end of each chapter to facilitate further study Extensively updated and expanded since the publication of Walter F Loeb and Fred W Quimby s second edition in 1999 the new The Clinical Chemistry of

Laboratory Animals Third Edition continues as the most comprehensive reference on in vivo animal studies By organizing the book into species and organ class specific chapters this book provides information to enable a conceptual understanding of clinical chemistry across laboratory species as well as information on evaluation and interpretation of clinical chemistry data relevant to specific organ systems Now sponsored by the American College of Laboratory Animal Medicine ACLAM this well respected resource includes chapters on multiple laboratory species and provides pertinent information on their unique physiological characteristics methods for sample collection and preanalytical sources of variation for the particular species Basic methodology for common procedures for each species is also discussed New Chapters in the Third Edition Include The Laboratory Zebrafish and Other Fishes Evaluation of Cardiovascular and Pulmonary Function and Injury Evaluation of Skeletal Muscle Function and Injury Evaluation of Bone Function and Injury Vitamins Development of Biomarkers Statistical Methods The Clinical Chemistry of Laboratory Animals Third Edition is intended as a reference for use by veterinary students clinical veterinarians veterinary toxicologists veterinary clinical pathologists and laboratory animal veterinarians to aid in study design collection of samples and interpretation of clinical chemistry data for laboratory species [ILAR News](#) Institute of Laboratory Animal Resources (U.S.),1992 *Swine Nutrition* Austin J. Lewis,L. Lee Southern,2000-12-21 With 42 chapters authored by leading international experts *Swine Nutrition* Second Edition is a comprehensive reference that covers all aspects of the nutrition of pigs Content includes characteristics of swine and the swine industry with emphasis on the gastrointestinal tract various classes of nutrients how these nutrients are metabolized by swine and the factors affecting their utilization the practical aspects of swine nutrition from birth through gestation lactation in sows and the feeding of adult boars and nutritional aspects of the various feedstuffs commonly fed to swine Rounding the book is coverage of various techniques used in swine nutrition research **Biomaterials Science** Buddy D. Ratner,Allan S. Hoffman,Frederick J. Schoen,Jack E. Lemons,2012-12-31 The revised edition of this renowned and bestselling title is the most comprehensive single text on all aspects of biomaterials science It provides a balanced insightful approach to both the learning of the science and technology of biomaterials and acts as the key reference for practitioners who are involved in the applications of materials in medicine Over 29 000 copies sold this is the most comprehensive coverage of principles and applications of all classes of biomaterials the only such text that currently covers this area comprehensively *Materials Today* Edited by four of the best known figures in the biomaterials field today fully endorsed and supported by the Society for Biomaterials Fully revised and expanded key new topics include of tissue engineering drug delivery systems and new clinical applications with new teaching and learning material throughout case studies and a downloadable image bank *Swine in Biomedical Research* Mike E. Tumbleson,1986 [Energy Research Abstracts](#) ,1977 Semiannual with semiannual and annual indexes References to all scientific and technical literature coming from DOE its laboratories energy centers and contractors Includes all works deriving from DOE other related government sponsored information and foreign nonnuclear information Arranged

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International Symposium, Swine in Biomedical Research ,1995 *Journal of the American Veterinary Medical Association* ,1992 **Swine Nutrition** Elwyn R. Miller,Duane E. Ullrey,Austin J. Lewis,1991 Interdependencies of swine and humans Development of nutritional capabilities Nutrient utilization by swine Factors influencing swine nutrition Applied feeding of swine Feeding unique feedstuffs to swine Techniques in swine nutrition research *Swine Research Report* ,1993

**SWINE IN CARDIOVASCULAR RESRCH** Mersman,1986-09 The Biology of the Pig Wilson G. Pond,Katherine A. Houpt,1978 The pig as a model in biomedical research Behavior Prenatal development Postnatal development Reproductive Physiology Lactation and the mamary gland Anesthesia blood sampling and surgery Body fluids hematology and immunology Nutriton Husbandry handling and restraint *Proceedings of the Society for Experimental Biology and Medicine* Society for Experimental Biology and Medicine (New York, N.Y.),1986 List of members in each volume

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