Hair Loss Disorders in Domestic Animals

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It is with greatest pleasure and enthusiasm that I am writing these introductory lines to what has turned out to be a much-needed, authoritative, and most informative new monograph on hair growth disorders in domestic animals—one of the major topics of clinical dermatology, not only in human but also in veterinary medicine.

The editors have done an admirable job in charting a difficult territory marred by the unavailability of sufficient analytical research, by confusion about key underlying biological principles, by often rather vague pathogenesis concepts, and by contradictory, misleading, or ill-advised terminology. Together with an excellent, international team of expert contributors, the editors are offering solid guidance and a fresh perspective on how to approach alopecias in domestic animals from the vantage point of modern skin and hair biology in a very systematic manner, and thus convincingly fill a void in the available veterinary literature.

As a clinical dermatologist with a special interest in basic hair biology and human hair pathology, I am fully aware of the importance and instructiveness of alopecia in domestic animals for dissecting the principles that control hair follicle cycling, and for studying how cycling disorders can lead to hair loss. I also realize the major, as yet insufficiently exploited potential of domestic animals as excellent models for the study of human hair disease. Therefore, the editors are to be congratulated for calling our attention to the multiple, but often neglected parallels between human and animal hair loss, and for the highly methodical, well-structured approach they are taking in presenting the topic at hand.

Mirroring the often merely historical and commonly descriptive rather than pathobiologically founded classification of human alopecias, the even less studied animal alopecias are notoriously difficult to classify. The editors and chapter authors have done a marvellous job in providing pragmatic guidance and a reasonable working classification that generally avoids to fall into the trap of drawing unadvisedly close parallels to suspected “analogous” human forms of alopecia, whose pathogenesis may well be distinct from what is conceived as a counterpart in domestic animals.

Thus, one does not have to be a prophet to predict that this unique new monograph—a most welcome enrichment of the veterinary dermatology literature—will soon also be consulted by many investigators across a wide range of the life sciences, who are interested in the principles that drive hair loss disorders in mammalian species or who are looking for instructive animal models of specific alopecias, beyond what mice and rats have long offered in this respect.

May this exquisite new book enjoy the exceptionally long “anagen” phase it deserves!

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Preface

With the loss of its relevance as a thermal regulator in mammalian survival, the psychosocial significance of hair for humans has continuously increased. Therefore, it is not surprising that domestic animals with alopecia are increasingly presented by their owners to veterinarians for treatment. As with physicians, the veterinary clinician is confronted with a difficult task, since the pathogenesis of alopecia can be very complex and therapeutic possibilities very limited. The aim of this book is to help with the understanding and diagnosis of alopecia and to demonstrate what therapeutic options are available to both the veterinarian and client. As the diagnosis of alopecia frequently relies on a histopathological evaluation of the hair-bearing skin, this book is aimed not solely at practicing veterinarians, but also veterinary pathologists who work with skin biopsies from alopecic patients.

Above all, the diagnosis and treatment of alopecia should be grounded on a thorough understanding of hair follicle anatomy and physiology, and particularly on how this may differ between species. To this end, our book begins with a detailed introduction into the basics of hair follicle biology. Moreover, it provides an insight into the variety of spontaneous alopecic diseases in domestic animals. This will hopefully stimulate new thinking on the etiology and pathogenesis of alopecia, and aid researchers in their search and development of new therapeutics for alopecia.

As Hopwood claimed in 1957, “the urge to classify is a fundamental human instinct; like a predisposition to sin, it accompanies us into the world at birth and stays with us to the end” (Hopwood AT. Proceedings of the Linnean Society of London 1957;171:230). As is true for other diseases, the classification of alopecias continues to become more and more complex as new disease entities are described. Our system of classification significantly extends that of previous literature on veterinary alopecia, and reflects this increasing complexity. We consider that histopathologic and clinical features of disease are the most relevant parameters for classification and aim to be as descriptive and precise as possible in our system. This classification however remains in a state of flux, and will no doubt be further improved over the next decades. As was so well expressed by H.E.M. Kay (The Lancet 1974;11:586) when addressing lymphoma classification: “This system makes no claim to be comprehensive or even comprehensible, so there may well be scope for other classifications of classifications and ultimately, one hopes a classification of classifications of classifications. At that point we shall need a conference in the Caribbean.”

Finally, we would like to thank all those who have enabled us to compile this book. Among many others, these are: Zeineb Alhaidari, Ellen Baumeister, Luc Beco, Kerstin Bergvall, Jan Declercq, Claude Favrot, Raffaella Finocchiaro, Marion Gähle, Szymon Godynicki, Thelma Lee Gross, Renate Hämmerling, Rubert Judd, Miguel Angel Toro Ibáñez, Markus Maget, Kevin McElwee, Claudia Nett, Thierry Olivry, Ralf Paus, Eva M.J. Peters, Sylvia Ruefenacht, Neil Sargison, Rudolf Schwarz, David Steffen, Gudrun Wirth, Pat White, Stephen White, Yulie Yager, and the team from the Section of Clinical Dermatology and the Institute of Veterinary Pathology of the Vetsuisse Faculty, University of Berne.

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Part 1

Hair Follicle Biology

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Both humans and domestic animals communicate significantly via their physical appearance, and the hair fiber-producing mini organ called the hair follicle accounts for much of the variation in domestic mammal phenotype. Although commonly dismissed as being of superficial importance, the hair follicle is truly one of the nature’s most fascinating structures (Chuong 1998). Hair growth, one of the only two uniquely mammalian traits (the other is the mammary gland), serves several important functions. These include thermal insulation, camouflage, social and sexual communication, sensory perception, and protection against trauma, noxious insults, insects, and so on. These features have clearly facilitated evolutionary success in animals.

The hair follicle or, as it is known in humans, the “pilosebaceous unit” encapsulates all the important physiologic processes found in mammalia, including controlled cell growth and death, interactions between cells of different histologic type, cell differentiation and migration, and hormone responsitivity. Thus, the value of the hair follicle as a model for biological scientific research goes way beyond its scope for cutaneous biology or dermatology alone. Indeed, the recent and dramatic upturn in interest in hair follicle biology has focused principally on the pursuit of two of biology’s holy grails: post-embryonic morphogenesis and control of cyclical tissue activity.

If one first considers the role of the skin, arguably our body’s largest organ, as the mammal’s sensor at the periphery (a veritable “brain on the outside”), one can begin to appreciate some of the contributions its principal appendage, the hair follicle, can make. The skin incorporates all major support systems found in the body: blood, muscle, and innervation as well as its role in immunocompetence, psycho-emotion, ultraviolet radiation sensing, and endocrine function, among others. These participate in the homeostasis of the mammalian body. Not surprisingly, therefore, the skin contains several reservoirs of stem cells located in the epidermis, the hair follicle, and perhaps also the sebaceous gland.

The hair follicle is formed from a bewilderingly complex set of interactions involving ectodermal, mesodermal, and neuroectodermal components, which go to elaborate five or six concentric cylinders in humans of at least 15 distinct interacting cell subpopulations. These together provide a truly exceptional tissue that rivals the vertebrate limb bud as a model for studies of the genetic regulation of development. Much of the research on the regulation of hair follicle development or morphogenesis has been carried out in murine models, especially the mouse (Schmidt-Ullrich and Paus 2005). While some species-specific (and even intraspecies) differences are expected (Drögemüller et al. 2007), it is considered likely that broadly similar pathways and molecular regulators will operate in all mammals. Thus, the discussion below will largely refer to data that continues to emerge from studies in mice, given the ready availability of powerful mouse genetics.

The mysteries of the “creation” of the hair follicle in mammalian skin have only just recently begun to be unraveled. As with any highly complex multicellular structure that has experienced enormous evolutionary selective pressure, nature’s master builder has designed the hair follicle with multiple levels of redundancy: with backup systems and with backup systems for these backup systems. A plethora of excellent reviews have appeared over the last 10 years that describe the exquisitely complex molecular mechanisms active during hair follicle development (Fuchs