Exploring vertebrate sexual differentiation

Sexual Differentiation of Vertebrate Reproductive Organs

Editors
Marilyn B. Renfree
Humphrey H.-C. Yao

This special topic issue on Sexual Differentiation of Vertebrate Reproductive Organs continues and complements the story that was first taken up in a previously published issue dealing with the Control of Gonadal Development. This new publication focuses on the transition from sex determination to sexual differentiation. Due to the fact that most work has been conducted on mice, it is not surprising that many generalisations have developed, even though only some of these apply to all mammals. This special topic issue aims to shed some light on these generalisations. It covers the different mechanisms of sex determination in mice, reptiles and birds. Further insights are provided on the somatic lineages, gonadal differentiation and disorders of sexual development in mammals, fishes and humans. The last few chapters focus on the development and molecular control of the duct system and the development of external genitalia in mammals and also discuss how these evolved in reptiles.

This publication is recommended for anyone who would like to know more about what directs male and female sexual dimorphisms at molecular, cellular, developmental, physiological and endocrinological levels.

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Aims and Scope
Recent experimental and clinical research have led to impressive advances in our knowledge of the genetic and environmental mechanisms governing sex determination and differentiation, their evolution as well as the mutations or endocrine and metabolic abnormalities that interfere with normal gonadal development. The new journal Sexual Development aspires to provide a unique forum for this rapidly expanding field. Its broad scope will cover all aspects of genetics, molecular biology, embryology, endocrinology, evolution and pathology of sex determination and differentiation in humans and animals. It will publish high-quality original research papers, review articles, short reports, case reports and commentaries. Sexual Development is a modern journal managed by an internationally renowned and multidisciplinary editorial team of three Chief Editors and ten prominent scientists serving as Section Editors, supported by a distinguished panel of editorial board members. They are committed to ensuring fast and author-friendly editorial processing and peer reviewing. Contributions from the scientific community are invited to make Sexual Development the long-awaited and viable forum for basic and medical research on sex determination and differentiation.

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Sex determination, the mechanism by which embryos are committed to develop as either males or females, has been the subject of intense research during the last two decades. Gonadal development, which is a crucial event of sex differentiation, involves complex cellular processes, including the differentiation of several cell types, cell proliferation and migration as well as vascularization, which take place differently in male and female embryos. This special issue of Sexual Development presents a series of 12 articles describing the state of the art of the control of gonad development in mammals and other vertebrates. Several of the most renowned international experts in the field of sexual development review the genetic, hormonal and environmental operators controlling gonad development in mammals, birds, reptiles, amphibians, fish and nematodes, as well as the cases of sex reversal and gonad abnormalities derived from mutations in the human and other mammals.

Providing both basic and advanced insights into the control of gonadal development in a variety of animal taxa, this issue is essential reading for both students and researchers in the fields of genetics, developmental and reproductive biology, zoology and evolutionary biology.

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Understanding Differences and Disorders of Sex Development (DSD)

O. Hiort
S. Faisal Ahmed

Ten years ago a group of experts assembled in Chicago to develop a consensus on the management of conditions previously described as intersex. The consequences of this consensus have been far reaching, including a change in nomenclature, the development of greater collaboration across geographical boundaries, and a move towards greater involvement of patients and parents. Moreover, an international registry was established, as well as research and clinical networks.

This book brings together a thorough overview on all these topics. Furthermore, the major technological advances in diagnostic genetic and biochemical capabilities over the past 10 years are outlined in detail.

Offering a comprehensive update on various aspects of disorders of sex development (DSD), this book will be essential reading to all clinicians who are involved in delivering health care to patients with a DSD, as well as scientists involved in biomedical research related to DSD.

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Three conditions are essential for evolution: variation, heredity and time. Most animal species transmit genetic information through sexual reproduction in order to meet the first two conditions. The consequence for sexual reproduction is the need for (at least) two sexes with different reproductive roles. Consequently, evolutionary issues arise, such as differences in morphological and behavioral attributes between the sexes, which are reflected in the plethora of animal sex-determining systems. Indeed, a transition to asexual development may occur, sometimes induced by microbial endosymbionts. All these aspects are represented in the insect sex-determining system, which is the focal topic of this issue of Sexual Development.

Sex Determination and Differentiation in Insects is recommended to scientists interested in the evolution of sex determination in particular and developmental pathways in general.

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Recent discoveries in experimental and clinical research have led to impressive advances in our knowledge of the genetic and environmental mechanisms governing sex determination and differentiation, their evolution as well as the mutations or endocrine and metabolic abnormalities that interfere with normal gonadal development. Sexual Development provides a unique forum for this rapidly expanding field. Its broad scope covers all aspects of genetics, molecular biology, embryology, endocrinology, evolution and pathology of sex determination and differentiation in humans and animals. It publishes high-quality original research manuscripts, review articles, short reports, case reports and commentaries. An internationally renowned and multidisciplinary editorial team of three chief editors, ten prominent scientists serving as section editors, and a distinguished panel of editorial board members ensures fast and author-friendly editorial processing and peer reviewing.

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• Variable Loss of Functional Activities of Androgen Receptor Mutants in Patients with Androgen Insensitivity Syndrome: Elfferich, P.; van Royen, M.E.; van de Wijngaart, D.J.; Trapman, J.; Drop, S.L.S.; van den Akker, E.L.T. (Rotterdam); Lusher, S.J. (Amsterdam); Bosch, R. (Oss); Bunch, T.; Hughes, J.A. (Cambridge); Hou全民, A.B. (Rotterdam); Cools, M. (Ghent); Faradz, S.M.H. (Ghent); Bischop, P.H.; Bund, G. (Amsterdam); Oostdijk, W. (Leiden); Brüggenwirth, H.T.; Brinkmann, A.O. (Rotterdam)
• Insights into the Evolutionary History of the X-Linked Sex Reversal Mutation in Mus minutoides: Clues from Sequence Analyses of the Y-Linked Sry Gene: Veyrunes, F.; Perey, J. (Montpellier); Paintsil, S.N.C. (Accra); Fichet-Calvet, E. (Hamburg); Britton-Davidian, J. (Montpellier)
• Follistatin is an Early Player in Rainbow Trout Ovarian Differentiation and is Both Colocalized with Aromatase and Regulated by the Wnt Pathway: Nicol, B.; Yano, A.; Jawa, A.; Guérin, A.; Fostier, A.; Guilou, Y. (Rennes)
• Sex Determination in Insects: Variations on a Common Theme: Bopp, D. (Zurich); Saccone, G. (Naples); Beye, M. (Düsseldorf)
Providing new insights into the developmental mechanisms involved in the evolution of external genitals, the articles in this special issue provide a comparative analysis across terrestrial vertebrates. The evolutionary transition from external to internal fertilization in vertebrates was facilitated by the emergence of novel organs, the external genitals. Reptiles as well as birds exhibit remarkable phenotypic diversity, ranging from the paired hemipenises of snakes and lizards, to the elaborate corkscrew penises of waterfowl, and to the complete absence of an intromittent penis in most birds.

This special topic issue presents new studies on the external genital development in birds, lizards, snakes, alligators, and turtles. The articles discuss new insights into the evolutionary developmental biology (‘evo-devo’) of external genitals and provide explanations for the evolution of human congenital malformations, such as hypospadias. Offering novel perspectives on the evolution of reproductive organs, **Evolution of External Genital Development** will be of special interest to developmental and reproductive biologists as well as comparative and evolutionary morphologists.

Schematic illustrations of reptile embryos at early (top row) and late (bottom row) stages of external genital development. Morphogenesis of the reptilian phallus begins with emergence of two buds called the genital swellings in turtles (first column on left), alligators (second column), and birds (third column); and the hemiphallic swellings in squamates including snakes (fourth column) and lizards (fifth column, on right). At later stages, the genital swellings fuse to form the genital tubercle, the anlagen of the male penis and female clitoris, whereas the hemiphallic swellings remain separate and mature into the male hemipenes and female hemiclitores. Drawings by M. Gredler and F. Leal.