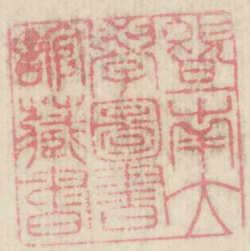
SELECTED PAPERS ON PLANNED PARENTHOOD

计划生育专题论文选集



VOLUME 6

Research of Contraceptive Agents for Male

男用避孕药研究

Selected Papers on Planned Parenthood

Vol. 6

Research of Contraceptive Agents for Male

October 1975

中　文　摘　要

综　述

本文阐述了近年来关于男性生殖生理研究的几方面进展：

(一) 睾丸中液体产生的动力学：包括睾丸血流的测定，影响血流的因素，逆流换热机制，曲精细管内液体产生及其影响因素。

(二) 睾丸中的酶：酸性磷酸酶，氨基酞酶，己糖激酶，乳酸脱氢酶，山梨醇脱氢酶等。

(三) 曲精细管中的激素：雄激素的产生，对 FSH 水平的调节。

本文介绍了男性避孕的三种可能途径：(1) 精子发生过程，包括精子排放与运转的干扰；(2) 干扰精子在副睾中的成熟过程；(3) 干扰副性腺的正常生理活动。然后分别阐述干扰下丘脑——垂体——性腺轴药物、直接抗精子发生药物以及作用于副睾药物（如 α-氯代甘油）各自的作用机理及优缺点，并指出今后研究的方向和途径。

精　子　发　生

本文全面而详尽地综述了哺乳动物的生精过程以及精原细胞的更新模式。

文中首先介绍了哺乳动物睾丸中曲精细管内的各类细胞的特点，然后叙述整个生精过程。在叙述生精过程中，提出了生精周期和生精细胞组合的概念。最后综述了大鼠、小鼠、田鼠、豚鼠、羊、牛、猴及人类精原细胞更新的模式。

本文首先讨论了哺乳动物精子发生的一般过程，说明精子发生是一个严格而有序的动态过程。

然后将人睾丸曲精细管的组织结构与一般实验动物加以比较，发现人类的精子发生的严格有序性不及其他动物，指出了人类精子发生动力学上的几个特点。

本文最后介绍了用氚标记的胸腺嘧啶作为示踪物来测定人的整个生精周期的持续时间，发现每个细胞周期延续 16 天，整个生精过程占据 3.8 个周期，故为 61 天左右。

男性生殖器官的超微结构

雄性内分泌研究

CONTENTS

Review
综述

Spermatogenesis
精子发生

Ultrastructure of Male Reproductive Organs
男性生殖器官的超微结构

Male Hormone Research
雄性内分泌研究

Research of Discoveral Contraceptive Agents for Male
探索性的男用避孕药研究

Some Experimental Methods & Technic
一些实验方法与技术

Review

THE MALE REPRODUCTIVE SYSTEM

◆1114

W. R. Gomes and N. L. VanDemark
Animal Reproduction Teaching and Research Center, The Ohio State University, Columbus

INTRODUCTION

This paper marks the first appearance in the *Annual Review of Physiology* of a review devoted exclusively to male reproductive phenomena. Obviously space limitations make it impossible, under the circumstances, to comment on all articles published since the previous review on reproduction. Therefore, specific aspects of male reproduction have been selected for review in an attempt to update areas which appear of current interest in several laboratories. Even within these areas, the bulk of recent literature and space limitations force the use of secondary references for most earlier work, and citation of one or two papers in other cases where three or four would be preferable.

A number of recent reviews are available detailing many aspects of the male reproductive system which could not be covered here. The interested reader is referred to these for coverage of many facets of testicular (121) and epididymal (59) function, sperm transport (8) and testicular morphology (23), endocrinology (31), and pharmacology (64). Pre-1970 literature has been extensively summarized in recent treatises on male reproduction (68, 103, 107).

FLUID DYNAMICS IN THE TESTIS

In the last 10 to 15 years great strides have been made in understanding the dynamics of the fluids flowing into and out of the testes as a result of the development of adequate micro-methods of measuring blood, lymph, and testicular fluid flow. Since these fluids are responsible for supplying nutrients, hormones, and gases, and removing waste products and secretory products of the testes, it is clearly important that the processes involving these fluids be understood.

Earlier reviews have presented or referred to detailed methods for the measurement of blood flow (113, 142, 143) and have considered factors affecting blood flow and metabolism within the testis, epididymis, and scrotum, and discussed the blood

supply to the testis, testicular lymph, and lymphatics, and testicular fluid in the rete testis. Waites (140) has discussed the vascular role in countercurrent heat exchange in his review of temperature regulation in the testis.

Measurement of Blood Flow

As Setchell (113) has pointed out and documented with several references, one of the striking features of the vascular anatomy of the scrotal testis is the presence of a large number of convolutions in the internal spermatic artery in many species. This coiling of the artery occurs in the pampiniform plexus, just after the artery leaves the inguinal canal, with the convolutions forming a vascular cone. In primates there is only moderate coiling and in man the artery is nearly straight as it approaches the testis.

In the scrotal testis the veins usually arise within the substance of the testis and run either directly to the surface or to a central vein near the mediastinum. The veins then join the pampiniform plexus where they break up into many fine veins (numbering as many as 300 in a ram), which lie closely applied to the coils of the spermatic artery (141).

Within the testis the arteries follow different patterns of coiling on the surface and then descend into the interior portion of the testis, where they break down into arterioles and capillaries. In some cases there are arteriovenous anastomoses as well as capillaries (113).

Many of the techniques available for measuring blood flow cannot be used on reproductive organs because of the small size and slow flow rates of these organs in most species (113). Flowmeters employing electromagnetic or ultrasonic principles can be used for larger animals, but their application is limited. Use of the Fick principle, inert gas clearance rates, and indicator fractionation techniques have greatly enhanced our understanding of blood flow and its control.

Setchell (113) has also described methods of measuring the total venous outflow and of measuring capillary flow. Flowmeters—electromagnetic and ultrasonic devices that can be attached to arteries to measure inflow—present problems because the veins in the pampiniform plexus, if molested in exposing the internal spermatic artery, interfere with normal flow. Local thermal dilution methods also present difficulties because of the complex anatomy of the internal spermatic artery and veins. A diffusion method is described (113) which employs 4-aminoantipyrine as an indicator substance. This compound was originally used to measure uterine blood flow (62). This method also has been used with tritiated water as an indicator. The method is time consuming and there is no way of determining the proportion of the blood which is contributed by the testis itself and that which is contributed by the epididymis. Thus, while total metabolic change and total endocrine change can be determined, appropriate apportionment of these changes to segments of the testis and epididymis cannot be made. Capillary blood flow methods using ^{85}Kr and an indicator fractionation technique have also been reviewed in detail by Setchell. Other radioactive substance such as ^{86}Rb and 4-(^{131}I)-iodoantipyrine have been used as isotopes in blood flow techniques in the testis.

Jaffe & Free (65) recently developed a method of measuring blood flow in the

testis with a miniature friction flowmeter which operates at flowrates below the range of electronic flow sensors and can be used in arteries of the testis as small as 0.6 mm inside diameter.

The method relies on the measurement of the pressure drop across a small resistance. Using this technique, these investigators found very close agreement with methods using tritiated water and the Ludwig-type stromuhr procedure. The miniature friction flowmeter has been used successfully in monitoring the blood flow in the testis of a conscious rat up to 8 hr during treatment with various vasoactive substances. The method also permits the sampling of arterial-venous blood for analysis.

Factors Affecting Blood Flow

Using the method just described, Free & Jaffe (41) have reported large increases in testis tissue pressure caused by contractions in the testicular capsule which cause a concomitant increase in testis vein pressure and a small transient decrease in testis blood flow. When the testicular capsule was opened in the anesthetized rat, testis vein and artery pressure and blood flow were unaffected.

Infusion of epinephrine or norepinephrine into the spermatic artery of rats (65) or rams (142) led to a rapid vasoconstriction with a marked decrease in blood flow. The relationship of this finding to physiological events, however, remains obscure, as extensive treatment with large doses of epinephrine was necessary to cause significant changes in testes of rabbits and rats (50). On the other hand, definite relationships have been shown between testis function and crowding, social interaction, or other stresses (50), and adrenal contribution would likely play a role. Related to this is the recent report (136) that ACTH did not affect blood flow through the testis. Unfortunately, these workers (136) employed ^{86}Rb in an indicator fractionation technique, and the testis is one of three tissues known that partially excludes rubidium (113).

Other agents which can affect blood flow appear to be serotonin and prostaglandins (43), but the role of these compounds in normal in vivo function of the testis remains obscure.

Setchell (113) has reviewed several articles which indicate that the vascular bed of the testis is relatively unresponsive to heat changes, unlike most other organs where similar temperature changes bring increases in blood flow with increased temperatures and decreases with decreased temperatures. He also points out that blood flow to the testis increases following periods of vascular occlusion. Blood flow through the testis is also affected by the posture of the animal. This was found to be true when the scrotum the the ram was raised to the level of the heart, causing a doubling of the blood flow through the testis. Setchell (113) and Gunn & Gould (54) have reviewed, in some detail, the evidence for vascular disruption in the testis as a result of the effects of cadmium salts, which cause an immediate and profound fall in testicular blood flow. Other organs respond with only a slight reduction in blood flow as a result of the effects of cadmium salts.

Johnson & Turner (69) have confirmed the effects of cadmium on blood flow in the testis of the rat showing an increase 1 hr following the administration of