Autonomic Innervation of the Mammalian Penis: A Histochemical and Physiological Study

JoAnn McConnell, George S. Benson, and Joe Wood

Departments of Neurobiology and Anatomy, and Surgery (Division of Urology), University of Texas Medical School, UTHSCH, Houston, Texas, U.S.A.

With 9 Figures

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Summary

The distribution of adrenergic and cholinergic nerves was studied in penile tissue from rat, rabbit, cat, monkey and man. Glyoxylic acid histo-fluorescence and acetylcholinesterase-positive fibers were found in all tissues examined, but histofluorescent, presumably adrenergic fibers predominated. In general, except in the rabbit, more nerve fibers of both types were found in the corpus cavernosum (CC) than in the corpus spongiosum/penile urethra (CS). The rabbit penis showed slightly more adrenergic fibers in the CC than in the CS and more cholinergic nerves in the CS than in the CC. The CC of the monkey demonstrated an alpha receptor mediated contractile response to norepinephrine (NE) stimulation and no response to acetylcholine (ACh) in an in vitro muscle bath.

Introduction

Most morphological studies of the autonomic innervation of the human male reproductive system have been concerned with the duct system or the visceral part of the testes and the prostate (Baumgarten et al., 1968, 1971). Numerous studies have been conducted to determine the pattern of innervation of the mammalian vas deferens (rat: Richardson, 1962; Dixon and Gosling, 1972; guinea pig: Merrillees et al., 1963; Robinson, 1969; Wakade and Kirkepar, 1971; mouse: Yamauchi and Burnstock, 1969; rat, guinea pig and mouse: Furness and Iwayama, 1971; man: Baumgarten et al., 1968, 1971) and it has become evident that variations exist in the pattern of aminergic and cholinergic innervation in the different species.
Only a few workers have examined the innervation of the penis in mammals. Baumgarten et al. (1969), using histofluorescence techniques, found "typical" autonomic ground plexuses composed of many varicose adrenergic fibers in the cat and the monkey corpus cavernosum (CC), but only a "moderate" adrenergic nerve supply to the corpus spongiosum (CS). The penises of the bushbaby and the tree shrew were reported to have a rich adrenergic and cholinergic innervation, but the fluorescence of the adrenergic fibers in the tree shrew was more intense (Dail et al., 1971). Dail and Evan (1974) determined that the CC of the rat is supplied by abundant short adrenergics with the highest density in the proximal region of the penis. In contrast, Klinge and Penttila (1969) and Shirai et al. (1972) found respectively that the rabbit and the human corpora were innervated extensively by cholinergics but had only a sparse to moderate adrenergic component. The penis of the bull is reported to be nearly devoid of catecholamine-containing fibers and to have acetylcholinesterase (AChE)-positive fibers only in the CS, where they are present in moderate numbers (Klinge and Penttila, 1969). Klinge and Penttila (1969) also showed that both the bull and the rabbit have a higher density of nerve fibers in the CS than in the cavernous bodies. Monkeys, however, demonstrate NE in relatively high amounts in the CC when analyzed with microspectrophotometry (Baumgarten et al., 1969).

These data suggest that a considerable species variation exists in the autonomic nerve supply to the mammalian penis. In addition, there are technical variabilities involved in catecholamine histo-fluorescence as well as in acetylcholinesterase techniques which can lead to false negative results in the former and false positives in the latter. It was thought that a re-examination of some of these mammals with the more straightforward glyoxylic acid method for catecholamines might help to clarify the pattern of innervation of the penis.

Materials and Methods

Adult male penile tissue was obtained from four rats, three rabbits, four cats and two monkeys (one rhesus, Macaca mulatta and one stump-tail, Macaca arctoides). Human tissue came from six patients undergoing penectomy in transsexual gender reassignment procedures. The transsexual patients ranged in age from 25—35 years and all had been treated with estinyl estradiol (1 mg/day) for at least one year prior to the operative procedure. That portion of the penis between the decussation of the crura proximally and the glans penis distally was removed and made available for the present study. Two of the cats were pretreated with 2.5 mg/kg of