ORIGINAL RESEARCH—ANATOMY & PHYSIOLOGY

The Visceromotor and Somatic Afferent Nerves of the Penis

Djibril Diallo, MD, PhD,*†1 Mazen Zaitouna, MD,*†1 Bayan Alsaid, MD, PhD,* Jeanine Quillard, MD,‡ Nathalie Ba,§ Rodrigue Sètchéou Allodji, MD, PhD,¶ Gérard Benoit, MD, PhD,* Dina Bedretdinova, MD,¶ and Thomas Bessede, MD, PhD*†

*U1195 (Neuroprotective, neuroregenerative and remyelinating small molecules), University Paris-Sud, INSERM, Le Kremlin-Bicêtre, France; †Urology Department, University Paris-Sud Hospital of Bicetre, Le Kremlin-Bicêtre, France; ‡Anatomic Pathology Department, University Paris-Sud Hospital of Bicetre, Le Kremlin-Bicêtre, France; §INSERM i2b Institute, University Paris-Sud, Le Kremlin-Bicêtre, France; ¶INSERM CESP U1018 Institute, University Paris-Sud, Villejuif Cedex, France

DOI: 10.1111/jsm.12851

ABSTRACT

Introduction. Innervation of the penis supports erectile and sensory functions.
Aim. This article aims to study the efferent autonomic (visceromotor) and afferent somatic (sensory) nervous systems of the penis and to investigate how these systems relate to vascular pathways.
Methods. Penises obtained from five adult cadavers were studied via computer-assisted anatomic dissection (CAAD).
Main Outcome Measures. The number of autonomic and somatic nerve fibers was compared using the Kruskal–Wallis test.
Results. Proximally, penile innervation was mainly somatic in the extra-albugineal sector and mainly autonomic in the intracavernosal sector. Distally, both sectors were almost exclusively supplied by somatic nerve fibers, except the intrapenile vascular anastomoses that accompanied both somatic and autonomic (nitrergic) fibers. From this point, the neural immunolabeling within perivascular nerve fibers was mixed (somatic labeling and autonomic labeling). Accessory afferent, extra-albugineal pathways supplied the outer layers of the penis.
Conclusions. There is a major change in the functional type of innervation between the proximal and distal parts of the intracavernosal sector of the penis. In addition to the pelvis and the hilum of the penis, the intrapenile neurovascular routes are the third level where the efferent autonomic (visceromotor) and the afferent somatic (sensory) penile nerve fibers are close. Intrapenile neurovascular pathways define a proximal penile segment, which guarantees erectile rigidity, and a sensory distal segment. **Diallo D, Zaitouna M, Alsaid B, Quillard J, Ba N, Allodji RS, Benoit G, Bedretdinova D, and Bessede T. The visceromotor and somatic afferent nerves of the penis. J Sex Med 2015;12:1120–1127.**

Key Words. Anatomy; Cavernous Nerves; Computer-Assisted Anatomic Dissection; Corpora Cavernosa; Erection; Penis

Introduction

An erection is a tissue- and vessel-related phenomenon involving the endothelium [1]. The balance between contraction and relaxation factors determines the functional state of the penis via control of the smooth muscle of the corpora cavernosa (CC). Penile tumescence (rigidity) depends on nitrergic nerves (NO^+), whereas detumescence (flaccidity) depends on the adrenergic nerves (TH^+) [2]. These nerves are an extension of the efferent autonomic fibers of the pelvic plexus extending toward the CC. In the pelvis, they are located within neurovascular bundles (NVBs), which are in contact with the prostate and pass through the urogenital diaphragm, in contact with

[1]Equivalent contribution.

© 2015 International Society for Sexual Medicine

the urethra [3]. These NVBs are composed of cavernous (ventrolateral) and spongious (dorsolateral) parts [4].

In addition to this efferent autonomic (visceromotor) nervous system emerging from the pelvic plexus, there is an afferent somatic (sensory) system, arising from the pudendal nerves. These pudendal nerves follow a perineal route and ultimately become the dorsal nerves of the penis (DNPs). This is the principal somatic sensory route for the penis, supplying the outer layers, the foreskin, and the glans penis. It is also involved in reflex ejaculations in response to massage or vibration of the glans penis among patients with spinal cord injuries [5].

Penile innervation involves visceromotor pathways for erection and somatic pathways for sensitivity. Although these two systems are known to have pelvic and hilar contacts, their possible intrapenile pathways have not been explored [6–8]. In particular, a specific innervation of the intrapenile vasculatory anamastoses has been hypothesized but never investigated—despite its potentially important role in erectile physiology [1,9,10]. Finally, the functional distribution of the intrapenile nerve fibers has not been explored during conventional anatomic dissections.

The objective of the present study was to analyze intrapenile innervation using computer-assisted anatomical dissection (CAAD), to analyze the innervation of arterial shunts, and to systematically classify the distinct groups of penile nerves.

Methods

Preparation of Transverse Sections

Specimens were taken from five fresh male adult cadavers (68–85 years of age), who donated their bodies to scientific research. For the first subject, the entire visceral pelvis was removed from the bladder to the balanopreputial fold. The CC was completely detached along with the pelvic content, but the glans penis was left intact in order to return the body to the family. A 20-French Foley catheter was placed into the urethra to maintain alignment of the penis before fixation in 10% formalin for 24 hours. The specimen was divided into three parts of identical length. The "proximal" part of the penis (corresponding to the fixed portion) was considered the first part, whereas the mobile part was split into two: "intermediate" and "distal." The piece was then sliced into 5-mm sections before being mounted with paraffin. We obtained a series of seven transverse sections, which were differentially treated [11]: (i) a reference section was stained with hematoxylin–eosin (HE) or Masson's trichrome; (ii) a nerve fiber localization section was immunolabeled with anti-protein S100; (iii) an adrenergic/sympathetic fiber identification section was immunolabeled with anti-tyrosine hydroxylase (TH) [12]; (iv) a cholinergic/parasympathetic nerve fiber identification section was immunolabeled with anti-vesicular acetylcholine transporter (VAChT) [13]; (v) a nitrergic nerve fiber (erectile nerves) identification section was immunolabeled with antineural nitric oxide synthase (nNOS) [14]; (vi) an afferent sensory nerve identification section was immunolabeled by antiperipheral myelin protein-22 (PMP22) [15]; and (vii) a section was retained as a blank slide.

Three-Dimensional (3D) Reconstruction

The various stained and immunolabeled sections were used to perform 3D reconstructions. The HE-stained sections allowed us to distinguish the various anatomic structures. We used a Nikon Eclipse 80i (Nikon, Tokyo, Japan) microscope attached to a DXM1200F digital camera with optical zoom (4×, 10×, 20×, and 40×).

All nerve fibers with a diameter greater than or equal to 20 μm were quantified within the three penile regions (i.e., proximal, intermediate, and distal). Fibers inferior to 20 μm were disregarded as they were considered to be unsuitable for the CAAD technique. Nonmyelinated sensory fibers (C-fibers) were not specifically and separately labeled; however, they were labeled by the unspecific anti-protein S100.

Our computer system comprised a personal laptop (Windows XP) and an EPSON Perfection V750 digitalization system (Epson, Nagano, Japan). We also used the following software: SilverFast Ai (LaserSoft Imaging, Kiel, Germany), Adobe Photoshop (Adobe Systems, San Jose, CA, USA), and WinSurf v.4.3 (Golden Software, Golden, CO, USA).

Images of the histological sections were taken with a resolution of 3,200 dpi, and these were grouped together with Photoshop. Pelvic anatomic structures and nerve fibers were manually outlined in all sections, and a 3D analysis of their localization, course, and distribution was performed, producing an animated motion picture. Finally, a comparison of the number of fibers in each of the three parts was carried out using the Kruskal–Wallis test. For post hoc analysis, we calculated the least significant difference in mean

Download English Version:

https://daneshyari.com/en/article/4269672

Download Persian Version:

https://daneshyari.com/article/4269672

Daneshyari.com