Noradrenaline Content in Canine Lower Urinary Tract Tissue

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To examine the distribution of sympathetic nerve fibers in the lower urinary tract, the noradrenaline content was measured in the urinary bladder dome and base, and proximal and distal urethra of the male and female dogs, using high pressure liquid chromatography-electrochemical detection (HPLC-ED). The noradrenaline content was the highest in the proximal urethra and the lowest in the urinary bladder dome in both sexes. The noradrenaline content of the proximal urethra was significantly higher in the male than in the female, whereas the content of the urinary bladder base and the distal urethra was lower in the male than in the female. These data suggest that sympathetic innervation is the richest in the proximal urethra in the lower urinary tract and that there is a sex difference in the sympathetic innervation in the lower urinary tract.

noradrenaline content ; canine urinary bladder and urethra ; sympathetic innervation

It is generally accepted that noradrenaline content of peripheral sympathetic nerve terminals is a few hundred times as much as that of sympathetic nerve fibers (Dahlström and Håggendal 1966). A rich supply of sympathetic nerve terminals has been observed electromicroscopically in the urinary bladder and urethra (Gosling et al. 1977; Watanabe and Yamamoto 1979). Therefore, tissue noradrenaline content may reveal the distribution of sympathetic nerve fibers in tissue. In this study noradrenaline content in tissues of the lower urinary tract was measured, using high-pressure liquid chromatography-electrochemical detection (HPLC-ED) to examine the distribution of sympathetic nerves in the lower urinary tract.

MATERIALS AND METHODS

Eight male and six female adult (3-4 years of age) mongrel dogs weighing 10-15 kg were anesthetized with an intravenous injection of thiamylal sodium (15 mg/kg), and the urinary bladder and urethra was resected from the animal. The tissue was separated into bladder dome, bladder base, and proximal urethra (smooth muscle) and distal (membranous) urethra (smooth and striated muscle), each was approximately 100 mg.

All tissue specimens were immediately frozen in liquid nitrogen and stored in a

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deep-freezer until assay.

Analysis for noradrenaline content was carried out using HPLC-ED. 2.9 ml of 0.05 M HClO₄, 100 μl of 0.1 M EDTA-2Na, and 100 μl of NaHSO₃ were added to the frozen tissue and homogenized using Polytron® for 30 sec. The homogenate was centrifuged for 5 min at 3,000 rpm, 4°C and the supernatant was mixed with 30 mg of activated alumina and 2 ml of 1 M Tris-HCl (pH 8.6) was shaken for 10 min. The alumina to which noradrenaline had been absorbed was washed 3 times using 7 ml of distilled water and centrifuged for 3 min (4°C, 3,000 rmp). The alumina mixed with 100 μl of 0.15 N HCl was shaken for 10 min and was settled for 10 min. 10 μl of the supernatant was measured for noradrenaline analysis.

For analysis of noradrenaline, Yanagimoto HPLC-ED was used. The column was Yanagimoto ODST (4 mm x 250 mm) column, the temperature of column was maintained at 20°C, the mobile phase consisted of 0.1 M phosphate buffer, and the flow rate was 0.8 ml/min. The detector was volutantmetry type VMD-101 (Refshauge et al. 1974).

RESULTS AND DISCUSSION

The noradrenaline content of male canine lower urinary tract tissue was 0.23±0.06 (μg/g wet tissue) in the bladder dome, 0.39±0.09 in the bladder base, 2.94±0.32 in the proximal urethra and 0.41±0.09 in the distal urethra. That of female canine lower urinary tract tissue was 0.29±0.08 (μg/g wet tissue) in the bladder dome, 0.73±0.10 in the bladder base, 1.38±0.21 in the proximal urethra and 0.85±0.18 in the distal urethra (Table 1). The noradrenaline content was the highest in the proximal urethra and was the lowest in the urinary bladder dome in male and female canine lower urinary tract tissue. These data are consistent with those of recent studies which have revealed that α-adrenoceptor agonists strongly contract and α-adrenoceptor antagonists relax the proximal urethra (Benson et al. 1976; Hassouna et al. 1983). The noradrenaline content of the proximal urethra was higher in the male than in the female, whereas that of bladder base and distal urethra was higher in the female than in the male. These data suggest that there may be a sex difference on the sympathetic innervation in the canine lower urinary tract. The richer supply of sympathetic nerves in male proximal urethra may reveal its sexual function, that is to prevent retrograde

| Table 1. Noradrenaline content of canine urinary bladder and urethra in male and female dogs |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
|                                 | Bladder base                    | Proximal urethra                | Distal urethra                  |
| Male                            | 0.39±0.08ª                     | 2.94±0.32ª                     | 0.41±0.09ª                     |
| (n=7)                           | (n=8)                           | (n=8)                           | (n=7)                           |
| Female                          | 0.73±0.10ª                     | 1.38±0.21ª                     | 0.85±0.18ª                     |
| (n=6)                           | (n=6)                           | (n=6)                           | (n=6)                           |

Data are expressed as mean±s.d. (μg/g wet tissue). n means the number of dogs used.

(A) is significantly (p<0.01) higher than (B) and (C). (B) is significantly (p<0.01) higher than (C). (a) is significantly higher than (b) (p<0.05) and (c) (p<0.01). (b) is significantly (p<0.01) higher than (c). (A) is significantly (p<0.01) higher than (a). (b) is significantly (p<0.01) higher than (B).
ejaculation (Kimura 1970). The richer supply of sympathetic nerves in female bladder base and distal urethra may be concerned with the different urodynamic data of lower urinary tract (Bradley 1986).

References


