Critical Comment on the 'Trophic' Influence of the Effector Organ on the Sympathetic Nerves of the Male Sex Accessories of the Guinea-Pig

The male sex accessories of the guinea-pig have very large noradrenaline (NA) concentrations[1,2]. This is due to a very dense innervation by short adrenergic neurons of their smooth muscular compartments[3,4]. Recently[5] it was reported that the NA concentration of the vas deferens and the seminal vesicle of the guinea-pig remained stable, despite great changes in weight of the organs due to e.g. normal growth, castration or testosterone treatment: i.e. changes in size of the organs were followed by corresponding changes in transmitter amount. Therefore it was suggested that 'the effector organ is capable of maintaining a constant innervation density by exerting a trophic influence on nerves'. This is at variance with earlier results indicating that the NA concentration of the vas deferens and the seminal vesicle of the guinea-pig neither is the same in controls as in castrated or testosterone treated animals[6] nor is it the same in animals of different age[7]. Here some additional data are presented showing that there is no simple relationship between weight and NA content of the male sex accessories of the guinea-pig.

Material and methods. 48 young mottled guinea-pigs were used. 6 animals were killed at about 1 week of age and 6 animals were killed at about 2 months of age. Half of the remaining guinea-pigs were castrated at about 2 months of age and the other half served as untreated controls. 6 animals of each group were sacrificed 1, 2 or 6 months after operation. Of the 6 animals killed each time 4 were taken for determination of tissue catecholamines[8] in vas deferens and seminal vesicle as described earlier[2]. Pieces from the male sex accessories of 2 specimens were taken for fluorescence microscopy of monoamines[9]; the procedure being similar as in earlier reports[3,4].

Results and comments. The NA concentration of the vas deferens was very high 1 week postnatally. It fell during puberty but reached higher levels again when the animals became older (Figure 1). Castration in early puberty produced no significant reduction in total NA content of the vas deferens and the NA content remained close to the initial level during the whole observation period. Since there was a successive decrease in organ weight after castration the NA concentration of the vas deferens of castrated guinea-pigs successively increased and it was always higher than that of the corresponding controls (Figure 1).

The picture was similar in the seminal vesicle (Figure 2), but there was one apparent difference; although the NA concentration increased in the 'postpuberal' guinea-pig it never reached the 'prepuberal' level. Presumably this is due to the expansion of the secretory cells, almost devoid of adrenergic terminals[3,4], which occurs during puberty[10].

Castrated guinea-pigs had reduced secretory parenchyma[11] in all the sex accessories. (Vas deferens, seminal vesicle, coagulating gland and other prostates.) The smooth muscle cells were shrunken. Therefore, the adrenergic ground plexus had narrower meshes (cf. ref.[12]), giving

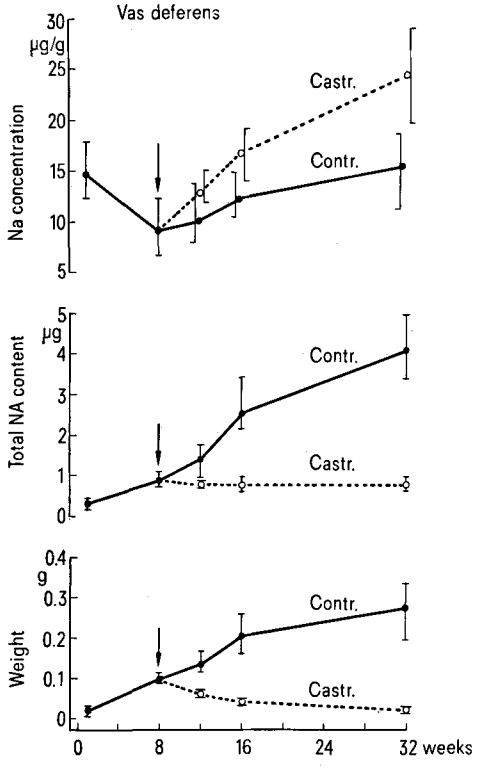

Fig. 1. Development of Na concentration, NA content and organ weight of the guinea-pig vas deferens (paired organs) between 1 and 32 weeks of age. The values are mean and range of 4 determinations. Arrow indicates time of castration. Filled circles and straight lines indicate values of controls, unfilled circles and dotted lines indicate values of castrated specimens. In no case does the total amount of NA in the vasa deferentia of castrated specimens deviate statistically from that of the vasa deferentia of 8-week-old controls, i.e. controls killed at the day of castration.

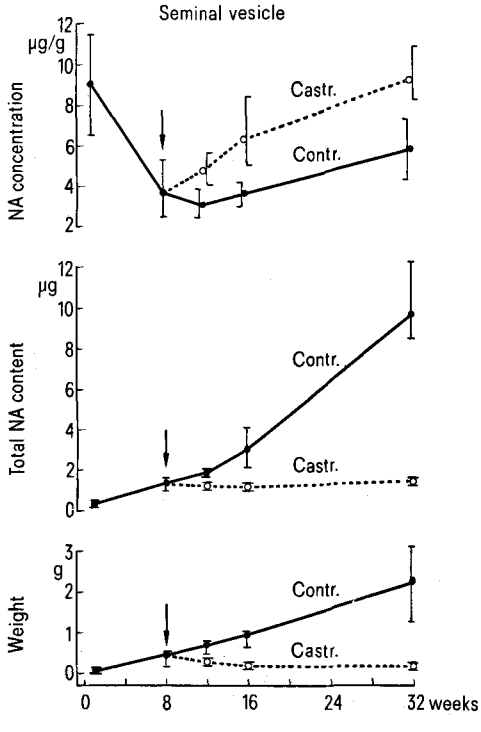

Fig. 2. Development of NA concentration, NA content and organ weight of the guinea-pig seminal vesicle (paired organs) between 1 and 32 weeks of age. The values are mean and range of 4 determinations. Symbols as in Figure 1. In no case is the total NA content of the seminal vesicles of castrated animals significantly lower than that of the seminal vesicle of 8-week-old controls.

the impression of an increased density of adrenergic terminals (Figure 3). The sex accessories of very young animals reminded of those of castrated animals and they had relatively increased smooth muscular compartments (cf. ref.[3,10]).

Discussion and conclusions. The very high NA concentrations of the vas deferens and the seminal vesicle from the 1-week-old guinea-pig when compared with organs from puberal guinea-pigs are probably explained by the circumstance that at this age the smooth muscle receiving an adrenergic innervation is relatively more developed than are the secretory linings in the genital tract[10]. Furthermore the guinea-pig, which is very well developed at birth may be in a stage of 'functional castration' 1 week post partum because of cessation of maternal and placental stimulation of the gonads. The increase in NA concentration of the sex accessories which occurs after castration is probably explained by the fact that the secretory compartments, almost lacking adrenergic terminals, diminish relatively more than the smooth muscle[11] and that the adrenergic terminals 'concentrate' due to shrinkage of the target cells.

The increase in NA concentration of the sex accessories which occurs when the animals age is likely to be due to an increased adrenergic innervation of the smooth muscle. Thus, electron microscopy of mouse vas deferens has revealed a progressive increase in number of nerve terminals to the muscle during and also after pubescence[13].

There is possibly some kind of 'trophic' influence exerted by the effector organ on its adrenergic nerves since the NA content increases when the organs grow, but the NA content runs not at all parallel to the weight increase. Finally it should be mentioned that the guinea-pig is probably a rather unsuitable animal for studies of hormonal influences on and growth of the male sex accessories. It is born well developed, grows slowly, with large individual variations (note e.g. weight ranges in Figure 2), and its target organs are comparatively little affected by castration as well as by androgen treatment[11,14-17].

Summary. There is no absolute parallelism between organ noradrenaline content and organ weight in the male sex accessories during normal development or following regression after castration.

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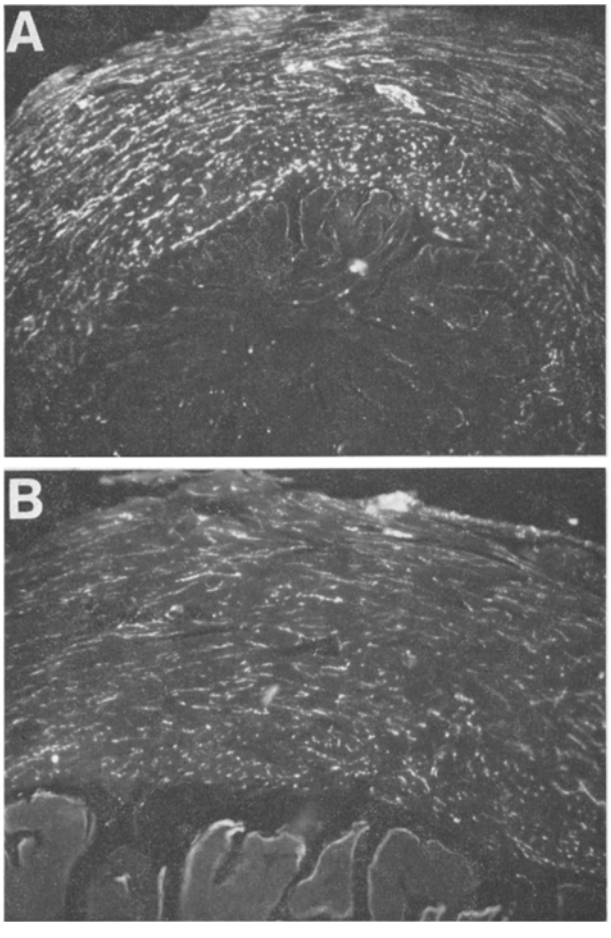

Fig. 3. A) Seminal vesicle from a 32-week-old guinea-pig castrated at the age of 8 weeks. B) Seminal vesicle from a 32-week-old control guinea-pig. Note the reduced secretory parenchyma (slightly autofluorescent cells in the lower part of the figures) and the shrunken muscularis with increased 'density' of fluorescent nerve terminals in A) when compared with B).

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