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Morphology of the Sacral Plexus of the Tapir

[With Plate III]

Examination was made of the sacral plexus and the nerves running from this plexus in a 32-year old tapir. The structural pattern of the sacral plexus and its nerves does not in principle differ from the pattern accepted for other ungulates. Certain differences were found in comparison with, for instance, the horse. The most important of these differences are: the absence of a distinct division of the sacral plexus into secondary, *i.e.* ischiadic and pudendal plexuses, the two emergences of the pudendal nerve from the pelvic cavity and the way in which the terminal parts of the medial and caudal rectal nerves join in one common trunk.

INTRODUCTION

The peripheral nervous system has been elaborated most thoroughly for man, the larger and domestic animals, but to a lesser degree for smaller monkeys and laboratory animals. The data to be found in literature on this system in other mammals are, however, somewhat scanty. As a result the nervous system is still insufficiently investigated and analysed from the point of view of comparative anatomy. It was therefore decided to examine this question in the tapir. An additional incentive was the fact that data treating of the behaviour of the peripheral nerves in exotic mammals may be of importance in the work of veterinary surgeons in zoological gardens.

There are no such data to be found in literature in relation to the tapir. There are, however, studies discussing the musculature (Bressou, 1961; Stiernmann, 1932) of this animal.

This study presents the results of investigations of the sacral part of the peripheral nervous system, that is the sacral plexus and its nerves. A male tapir 32 years old obtained from the Wrocław Zoo, was used for examination.

RESULTS AND DISCUSSION

The sacral plexus in the tapir is formed by whole ventral branches of the first four sacral nerves together with a similiar branch of the last, *i.e.* the 5th lumbar nerve, and also part of the branch of the penultimate lumbar nerve and the last sacral nerve.

The caudal part of the ventral branch of the 4th lumbar nerve connects with the ventral branch of the 5th nerve and also with a similar branch of the 1st sacral nerve. The above branches emerge from under the wing of the *os ilium* in the form of a board flat band which forms the beginning of the sciatic nerve, the cranial gluteal nerve and partly for the caudal gluteal nerve and caudal cutaneous femoral nerve.

The ventral branch of the 2nd and 3rd sacral nerve runs in the direction of the greater sciatic incisura, where the two branches join in a common trunk which comes into contact with the previously mentioned band. The branch of the 3rd sacral nerve, before this junction, sends a weak fascicle of nerve fibres to the branch of the 4th sacral nerve, from which in turn it receives a fairly strong nerve bundle. The trunk formed the junction of the branches of the 2nd and 3rd sacral nerve forms the beginning of the pudendal nerve and medial rectal nerve and partly also of the caudal gluteal nerve and caudal cutaneous femoral nerve.

It is clear from the above that it is impossible to distinguish a marked division of the sacral plexus into secondary, *i. e.* the sciatic and pudendal plexuses. It is only possible to discern a nerve plate of irregular shape, similar in appearance to a letter »H« placed in a horizontal position. These are in fact two bands — a superior (b, Fig. 1) and inferior (a, Fig. 1) connected by a corpus (c, Fig. 1). The beginning of the superior band is formed by branches of the 2nd and 3rd nerve, and the bundle of nerve fibres running from the branch of the 4th sacral nerve. The inferior band is formed by branches of the 5th lumbar nerve and 1st sacral nerve, and also bundles of nerve fibres from branches of the 4th lumbar nerve and 2nd sacral nerve. The corpus connecting the two bands is formed by the bundle of nerve fibres of the ventral branch of the 2nd sacral nerve, which passes from the superior to the inferior band.

In addition to the plate described above, another component of the sacral plexus is the ventral branch of the 4th sacral nerve, which after receiving bundles of fibres from the ventral branches of the 3rd and 5th sacral nerve passes into the caudal rectal nerve.

The elements forming the inferior band, after reaching the greater sciatic incisure, passes through the greater sciatic foramen out of the pelvic cavity to the external side of the sacro-sciatic ligament. The superior band is at first located on the pericentral side of this ligament, which it next pierces and through the opening formed in this way passes to the external side of the above-mentioned ligament. The ventral branch of the 4th sacral nerve, however, is situated throughout its

length on the pericentral side of the sacro-sciatic ligament and lies between it and the pelvic fascicle.

The cranial gluteal nerve (1, Fig. 1) begins from the inferior band. It is formed from the nerve fibres of the ventral branches of the two final lumbar nerves and first sacral nerve, but receives the largest number of fibres from the branches of the final lumbar nerve. This nerve separates in the form of a single nerve trunk, which only after it reaches the greater sciatic incisure divides up into several terminal branch. The strongest of these is directed almost vertically downwards and runs to the muscle tensing the broad femoral fascicle and to the anterior part of the superficial gluteal muscle. The remaining branch of this nerve innervate the medial, deep and accessory gluteal muscles.

In addition to the cranial gluteal nerve, a wide bundle of nerve fibres separates from the lateral surface of the inferior band and after receiving a weak bundle from the branch of the 2nd sacral nerve (from the superior band) forms the caudal gluteal nerve (2, Fig. 1). It contains fibres from the ventral branch of the final lumbar nerve and both the first sacral nerves. The percentage of nerve fibres from the branches of the first sacral nerve is the greatest. The trunk of the caudal gluteal nerve sends in turn 3—4 muscle branches intended for the superficial gluteal muscle and the vertebral head of *biceps femoris*. After sending out these branch, the caudal gluteal nerve is situated laterally from the caudal cutaneous femoral nerve and sciatic nerve, and then at the level of the greater trochanter bends slightly downwards and enters into *biceps femoris*, innervating the nodal head of this muscle.

After the two gluteal nerves leave the inferior band yet another small bundle of nerve fibres, belonging to a branch of the 1st sacral nerve, runs from this band in a dorsal direction to join with the fairly strong bundle of fibres of the superior band originating from the branch of the 2nd sacral nerve. The initial part of the caudal cutaneous femoral nerve forms from this connection (3, Fig. 1). This nerve lies laterally on the corpus connecting the two bands, almost parallel to the long axis of the body. At the level of the greater trochanter the caudal cutaneous femoral nerve runs slightly downwards and enters *biceps femoris* between its anterior and posterior heads, to which it sends branches. On the exterior, from between the two parts of the biceps, it emerges at the level of the third trochanter, where it divides up into two branches. The upper posterior branch (1, Fig. 2) is directed backwards and reaches to the skin of the region of *m. semitendinosus* and partly to *m. semimembranosus*. The lower branch by means of its branch running along the bundles of *biceps femoris* (2, Fig. 2) innervates the skin of the region of this muscle as far as the knee joint.

After sending out the above-mentioned nerves the inferior band passes into the initial part of the sciatic nerve (4, Fig. 1). The sciatic nerve is formed from the ventral branch of the 5th lumbar nerve and 1st sacral nerve, together with parts of such branches of the 4th lumbar and 2nd sacral nerve. This initial part lies on the external surface of the sacro-sciatic ligament, and later on the deep gluteal muscle and internal velar muscle. The sciatic nerve appears in the form of a wide and flat band, which after leaving the inferior band becomes narrower but thicker. From the lower margin of the sciatic nerve, in its initial part, a muscular branch separates and extends to *m. quadratus femoris*. The sciatic nerve next sends a second branch, stronger than the preceding one, running from the pericentral surface and upper margin of this nerve. This branch, at first single (4', Fig. 1) later divides into three parts. One of these runs dorsad to reach the pudendal nerve, forming a connecting branch between the latter and the sciatic nerve. The second runs obliquely in the direction of the lesser sciatic incisura and innervates the internal velar muscle. The third part, running parallel to the sciatic nerve, innervates *m. gemellus*. At the level of the sciatic spine the sciatic nerve sends a very strong proximal muscle branch (4'', Fig. 1). The terminal branch of this branch reach to the posterior part of the *biceps femoris* and to *semimembranosus* and *semitendinosus*.

Although the sciatic nerve forms one whole at the place of departure of the proximal muscle branch, it is possible to observe its division here into the tibial nerve (from which the branch described above arises) and the fibular nerve. This division, although visually distinct, is not complete, since the two nerves are connected by a strong band of connective and fatty tissue. This connection exists up to the midway along the thigh, although the distance between these two nerves increases. It is not until the further part of the thigh that the sciatic nerve is completely separated from the fibular and tibial nerves.

As mentioned above the second part of the sacral plate is formed by the superior band (b, Fig. 1) which passes into the pudendorectal trunk. This trunk has a characteristic system of nerve fibres. It is possible to distinguish what are apparently two layer — the superficial and the deep. The superficial layer is situated obliquely on the deep layer, directed slightly dorsad, and passes into the medial rectal nerve. The deep layer forms the beginning of the pudendal nerve, which runs backwards and slightly downwards.

The pudendal nerve (5, Fig. 1) is formed by ventral branches of the 2nd, 3rd and partly the 4th sacral nerve. At first it lies on the pericentral side of the sacro-sciatic ligament, then pierces it and emerges on its lateral side, running towards the lesser sciatic foramen, through

which it again enters into the pelvic cavity. In the pelvic cavity it is directed pericentrally and backwards lying on the plate of the ischii. The pudendal nerve next leaves the pelvic cavity through the sciatic arch and runs to the initial part of the external genital organs.

The medial rectal nerve (6, Fig. 1) is formed from the same elements as the pudendal nerve. After separating from the pudendorectal trunk it sends out a strong branch (6', Fig. 1) which near *tuber ischii* innervates with its branch the vertebral heads of *semitendinosus* and *semimembranosus*. It must therefore be considered as the muscular branch of the medial rectal nerve. In the pelvic cavity this nerve is situated to the side from the rectum, and pericentrally from the sacro-sciatic ligament and *tuber ischii*. Here also a small branch separates from the medial rectal nerve and reaches to the vertebral head of *semimembranosus*. After sending out this branch the medial rectal nerve connects with the caudal rectal nerve. The juncture of these two nerves takes place at the level of the middle part of *tuber ischii*.

The second part of the sacral plexus is formed by the ventral branch of 4th sacral nerve connected with bundles of fibres of a similar branch of the 3rd and 5th sacral nerve. The straight extension of this branch, together with the bundles referred to, passes into the caudal rectal nerve. It is directed backwards and slightly downwards, lying on the lateral wall of the rectum. This nerve along its course sends out small branches for the ischio-caudal muscle and the rectum. The caudal rectal nerve next connects with the medial rectal nerve. After a short joint course of the two nerves, this single trunk next separates into two branches. The first — the superior-pericentral — extends to the terminal part of the rectum and to its muscles and skin. The second — inferolateral passes into several terminal branches innervating the skin and muscles of the perineum.

The observations and remarks which the investigations suggest may be put concisely as follows:

The sacral plexus of the tapir exhibits a certain similarity to the sacral plexus in the horse (Sisson, 1960), but in details the plexus in these two animals exhibits certain differences. Among the more important of these is the course and behaviour of some of the nerves, for instance — the departure of the cranial gluteal nerve in a single trunk, and not several separate bundles, is the more interesting in view of the fact that it is not only in the horse that this nerve has a multi-fascicle structure from the time of its formation (Ryžih, 1962). In the cow and pig (Ryžih, 1962, 1964) and also in the sheep (Arłamowska-Palider, 1967) this nerve is similar to that in the horse.

In respect of the caudal cutaneous femoral nerve it was observed that it innervates the *biceps femoris*, and on the exterior it passes subcutaneously through a sulcus between the two heads of this muscle, and not as in the horse between the latter muscle and *semitendinosus*.

The pudendal nerve, which twice leaves the pelvic cavity, is very interesting. It emerges for the first time through the opening in the sacro-sciatic ligament, after which, running along the external side of the sciatic spine, it enters the pelvic cavity through the lesser sciatic foramen. It leaves the pelvic cavity for the second time through the sciatic arch. The relations are similar to that in man (Marciniak, 1963).

Two rectal nerves are very specific. They are joined in a common trunk, which next divides up into several branch. One of these, taking into consideration the region which it innervates, can be treated as the perineal nerve. It therefore contains nerve fibres both from the medial rectal nerve and the caudal rectal nerve.

REFERENCES

1. Arłamowska-Palider A., 1967: Badania morfologiczne splotu krzyżowego owcy.
2. Bressou C., 1961: La myologie du tapir (*Tapirus indicus*). *Mammalia*, 25, 3: 358—400. Paris.
3. Marciniak T., 1965: Anatomia prawidłowa człowieka. Państw. Zakł. Wyd. Lek., 3: Warszawa.
4. Ryžih A. F., 1962: Pojasnično-krestocovoe spletene lošadi i vzaimosvjazi ego s simpatičskim stvolom. Uč. Zap. Kazan. Vet. Inst., 85: 43—51. Kazan'.
5. Ryžih A. F., 1962: Morfologija pojasničnogo i krestovogo spletenija krupnogo rogatogo skota. *Ibidem*, 85: 52—60. Kazan.
6. Ryžih A. F., 1964: Pojasnično-krestovoje spletenie i nervy tazovykh konečno-stiej domašnej svini. *Ibidem*, 93: 22—28. Kazan'.
7. Sisson S., 1960: The anatomy of the domestic animales. Philadelphia.
8. Stiernmann R. O. G., 1932: Vergleichend-anatomische Studien über die Extremitäten-Muskulatur bei *Tapirus indicus*. Lund.

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MORFOLOGIA SPLOTU KRZYŻOWEGO TAPIRA

Streszczenie

Badania morfologiczne splotu krzyżowego i nerwów, odchodzących od tego splotu, przeprowadziliśmy na 32-letnim tapirze. W zasadzie schemat budowy splotu krzyżowego i jego nerwów nie różni się od schematu przyjętego dla innych przedstawicieli nieparzystokopytnych. Jednakże w szczegółach morfologia i topografia badanego odcinka obwodowego układu nerwowego tapira wykazuje pewne różnice w porównaniu np. z koniem. Do bardziej istotnych należy zaliczyć: brak wyraźnego podziału splotu krzyżowego na sploty wtórne tj. kulszowy i sromowy; dwukrotne opuszczenie jamy miednicowej przez nerw sromowy; połączenie się w jeden wspólny pień końcowych odcinków nerwów: odbytniczego środkowego i doogonowego.

EXPLANATION OF PLATE III.

Fig. 1. Sacral plexus in the tapir.

a — inferior band, b — superior band, c — corpus, 1 — cranial gluteal nerve, 2 — caudal gluteal nerve, 3 — caudal cutaneous femoral nerve, 4 — sciatic nerve, 4' — muscle branch, 4'' — proximal muscle branch, 5 — pudendal nerve, 6 — medial rectal nerve, 6' — muscle branch.

Fig. 2. Caudal cutaneous femoral nerve in the tapir.

1 — superior — posterior branch, 2 — inferior branch, a — *biceps femoris*, b — *semitendinosus*.



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