THE SENSORY PATHWAYS FROM THE SHOULDER JOINT

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The anatomy of the peripheral nervous system in man has been engaging increasing attention owing to the development of neurosurgery during the last few decades. One of the reasons why I have taken up the question of the innervation of the shoulder joint for closer examination is the knowledge that a Swedish surgeon, Dr. H. Wahren, in the course of the last few years, has made operative cuts of nerve branches running to the joints, as a last resort in certain states of severe pain. That surgical operations on the nerves of the joints require a thorough knowledge of the anatomy of those nerves is self-evident. From other points of view also, such knowledge is desirable. Pains in the shoulder joint and arms involve many still rather obscure problems and, even if these problems lie mainly in the sphere of physiology and pathology, it seems essential that the normal neuromorphological conditions should be ascertained so far as possible.

If we turn to standard textbooks on anatomy, we find there merely quite summary information on the origin and distribution of the articular nerves, and the same is true of even the large monographs on the peripheral nervous system by Hovelacque and Clara. The older textbooks, such as those by Cruveilhier, Henle, Quain, and Poirier and Charpy, give somewhat fuller accounts. The most detailed descriptions and illustrations of the articular nerves, however, have been given by Rüdinger, who, by minute dissections, followed the nerve branches to the joints as far as seems to have been possible. Unfortunately, however, he does not inform us on how large a material his description is based. A schematic representation of the innervation of the extremity joints, evidently based on Rüdinger's account, can be found in an atlas of the peripheral nerves by Hasse.

By numerous histologic investigations it has been shown that nerve branches run to the articular capsules and their ligaments, to the articular menisci and disci and to the glenoidal labra. That the hyaline cartilages are devoid of nerves is a generally accepted view, which tallies with the observation made by Bloch, Lenmander, and Nyström that hyaline cartilage is non-sensitive.

As regards the structure of the articular nerves, Rüdinger as far back as 1837 had suggested that the fibres of which they are constituted are of both encephalospinal and sympathetic origin. A more systematic investigation was made by Sherrington on cats and monkeys, and by Sasaoka on cats. The principal facts brought to light by these investigations are that the medullated fibres in the articular nerves have a calibre similar to that of the slenderer nerve branches to the skin, and that the articular nerves also
contain non-medullated fibres in the same proportion as in the said nerve branches. These observations thus afford morphological evidence that the joints receive both sensory and sympathetic nerve fibres, as is the case with the skin. The terminal branches of the articular nerves, their sensory nerve endings and fibres to the blood vessels have been described in detail by a large number of authors, such as Nicoladoni, Krause, Sfameni, Gerneck, and Gardner. The information I have found in the literature regarding the nerves of the shoulder joint in particular is derived almost entirely from Rüdinger's detailed macroscopic description; I have also consulted a minor anatomical investigation by Rauber. These investigations will be more fully reported in connection with the description of my own results.

MATERIAL. TECHNIQUE. TERMINOLOGY

It seemed unlikely that with the usual method, viz. dissection with or without the aid of a magnifying-glass, one could contribute appreciably more to the study of the joints than previous investigators, some of whom apparently attained the utmost skill in this technique. It was evident that recourse to other methods would be necessary.

In previous studies of the anatomy of the vegetative nervous system, I had adopted the following procedure: in serial sections of Ag-impregnated human fetuses I followed the nerves in the microscope and afterwards reconstructed them. This procedure is laborious, firstly in producing the serial sections and secondly in the execution of the reconstructions; on the other hand, it affords good prospects of making further progress than with the dissection method formerly adopted. One need not, as in dissection, reckon with the possibility that a nerve branch may be overlooked owing to its being torn off before it is detected. On the contrary, the preparation can be studied any number of times without its undergoing any change. In macroscopic dissection one cannot always determine with absolute certainty whether an observed fibre-like formation is a nerve branch or something else, without subjecting it to a histologic control examination. In the method advocated here, a complete serial section of each nerve branch in its whole extent always is obtained. Moreover, if a nerve branch penetrates into firm formations of connective tissue, as is the case e.g. with the articular nerves, it must obviously be very difficult macroscopically to follow the relatively fragile nerve branch for any considerable distance; here again the microscopic anatomical procedure is decidedly superior.

For studying the nerves of the shoulder joint, serial sections were made of three human fetuses, 77.5 mm., 74.8 mm. and 73 mm. in length, as well as serial sections of the right shoulder region from a fetus 215 mm. in length. All the material was impregnated with silver nitrate before sectioning, according to a previously described technique (Wrete). It is a well-known fact that the peripheral nervous system attains its full development at a very early stage; thus, at the 20 mm. stage the different nerve branches,