CLINICAL EXPERIENCES WITH NERVE GRAFTING

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INTRODUCTION AND SURVEY OF METHODS OF NERVE GRAFTING

Since the end of the 19th century many methods have been suggested for the bridging of large nerve defects, which cannot be closed by direct end-to-end suture. Before the first World War some successful results had already been achieved, but although a considerable number of nerve grafts undoubtedly have been performed since then, it is still uncertain whether grafting is justifiable in clinical practice and, if so, which technique should be regarded as the most suitable. The number of successful operations published hitherto is comparatively small and, especially in regard to the cases from the beginning of this century, it is often uncertain whether there really has been postoperative healing or whether the findings have merely been misinterpreted. Furthermore, there has been an evident discrepancy between results achieved in animal experiments and their practical application in man. Every new experience in this field may thus be of importance and the publication of even a modest series of results might be considered justified.

Before resorting to any kind of nerve grafting one must make sure that all possibilities of lessening the size of the defect have been taken into account, such as extensive mobilization of the nerve, stretching of the nerve ends, advantageous joint position, and eventually, when practicable, a rerouting of the nerve in order to straighten and shorten its course. As a rule these measures have not proved injurious to the result. Osteotomy with subsequent shortening of the bone has been suggested, but it is doubtful whether so large an operation should be considered, except in cases of fracture or pseudarthrosis.

There are three kinds of nerve transplants to be considered, namely the heterografts, the homografts, and the autografts. The first group mainly includes methods of mere historical interest (“suture à distance,” different types of tubulization etc.), by means of which no positive results in humans have ever been proved, although there are some records of successful animal experimentations. For the last ten years Gosset and Bertrand’s method of implanting formalin-fixed spinal cord of animals in man has attracted a great deal of interest. By means of this technique the authors in 1938 contended to have achieved not only positive but also qualitatively very good results in a number of cases and after surprisingly short intervals, sooner even than after direct end-to-end nerve sutures in general. Although num-
ernous animal experiments with the method of Gosset and Bertrand have rendered positive results,\textsuperscript{1,15,20,22} no certain signs of functional recovery have ever been observed by those authors who have applied the method in man.\textsuperscript{37,38} My own results, to which I shall return later, are also entirely negative.

Practically all experiments with fresh or preserved animal nerves have also proved totally ineffective in man.

As to the homografts, there is no doubt that in animal experimentation definitely positive results may be achieved, a fact proved in 1907 in studies by Huber\textsuperscript{18} and later by others.\textsuperscript{6,37,32,42} But whenever a homograft was implanted in man the result, with some few exceptions,\textsuperscript{19} was just as discouraging as when heterografts were used.\textsuperscript{4,31,35,40} Thus, it seems to be definitely proved that the human reaction differs greatly from that of the animals used in the experiments. Histologically it has been evidenced, that although the homograft is partly penetrated by new fibers, the fascicles of the distal uninnervated part of the graft soon undergo necrosis and are gradually replaced by fibrous tissue.\textsuperscript{4} It has been suggested that the necrosis might depend on the distal end of the transplant being less well nourished than the proximal one, and that consequently the character of the process was purely vascular. But this explanation is hardly correct, for in such a case it ought to hold good also in regard to the autografts. According to Seddon and Holmes\textsuperscript{35} and Barnes et al.,\textsuperscript{4} the reason is to be sought in an active immunity against the graft, gradually developed by the host. The fact that positive results may be achieved in animals is, according to these authors, due to the rate of penetration being so high that no immunity has had time to develop before the fibers have totally penetrated the graft. After this they are better guarded against the hostility of the host organism and are thus able to survive. The length of the graft traversed by axons is an index of the latent period during which the host acquires the active immunity (Seddon and Holmes\textsuperscript{35}). Yet it seems to be undeniable that the increase of fibrosis in the distal part of the transplant plays a part as an obstacle to nerve ingrowth.\textsuperscript{4,43}

Practically all the positive results in man have been achieved by means of autogenous nerve grafts. It has been histologically proved that during the process of regeneration the autograft upon the whole reacts like a normal peripheral stump and is innervated in a similar way; a real incorporation of the graft takes place.\textsuperscript{4,17,36} Either several thin nerves in a bundle (so-called cable grafts) or one thicker nerve of the same size as the damaged one may be used as autografts. If a full thickness graft is to be used it must naturally be taken from another of the motor or mixed nerves of the patient, which must thus be entirely sacrificed. Yet this method is practicable only if two nerves are simultaneously so severely damaged that neither of them can be sutured. In such a case a part of the less important nerve may be used as an implant.

Another technique of bridging a defect by autogenous grafting is when the implant is taken from the damaged nerve itself. This technique origi-