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Numerical Analysis of the Vestibular Nerve in Man

A Preliminary Report

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ABSTRACT

11 vestibular nerves from individuals of various ages ranging from birth to 85 years have been studied with regard to the numbers of nerve fibers. In this study it has been shown that young children have between 18 773 and 20 212 myelinated vestibular nerve fibers and that there is a clear and statistically significant reduction in number of fibers occurring with increasing age. The reduction averages 40% in the old age group. The study has included a separate investigation of all vestibular branches and the major reduction is found in the ampullary nerve fibers. This part of the observations will be separately published.

INTRODUCTION

It is a well known fact that the number of nerve fibres in the cochlear portion of the cochleovestibular nerve diminishes with increasing age (1). Our knowledge of the aging phenomena in the vestibular part of the nerve is very limited. A numerical analysis of this nerve has not been made since 1940, when Rasmussen reported that it contained between 14 200 and 24 000 fibres with an average number of 18 500. The existence of age-dependent degenerative changes has been denied by a number of authors (2, 3, 4, 5, 6, 9, 10) who have stated that apart from saccular degeneration the vestibular system remains essentially intact in contrast to the auditory system. In a recent study however, Rosenhall (8) has shown that the vestibular sensory epithelium is subject to a pronounced reduction in number of sensory cells with increasing age.

The purpose of the present study was to investigate the number of myelinated fibres in the vestibular nerve in man and to ascertain any reduction in number occurring with increasing age.

The study has also included a careful separation and investigation of the individual nerve branches but this part is not included in the present report.

MATERIAL AND METHODS

The left vestibular nerve from 11 individuals aged from birth to 85 years was examined. In no case was there a known history of neuro-degenerative disease, vestibular disorders, treatment with ototoxic antibiotics or irradiation therapy to the head. One person (HN27) with leukemia had been treated with a cytotoxic agent, cyclophosphamid (Sendoxan®) a few months prior to death but as she had one of the highest numbers of nerve fibres counted she has still been included in the series.

The nerves were embedded in Epon 812 (details of fixation, embedding and staining will be described in a later paper). The nerves were cross-sectioned at a preganglionic level, i.e. peripheral to the vestibular ganglion and the sections were mounted on glass slides. With the help of an ocular micrometer disc the fibres were counted at 500 × magnification. Since the vestibular nerve fibres occur in bundles that are irregularly separated by connective tissue and blood vessels, no sampling procedures could be used and it was necessary to count all fibres.

OBSERVATIONS

Age and number of nerve fibres for the 11 cases are shown in Table I. The 4 youngest, 1 day, 6 weeks, 22 years and 35 years, are assumed to have no major reduction in number of their nerve fibres and their values are therefore thought to represent what might be termed "normal values". This is in accordance with Rosenhall's (8) observations on the vestibular sensory cells where he finds no sizeable reduction of sensory cell population before the age of 40. In reality there seems to be a certain reduction in fibre count in the case aged 35 years but as a certain variation in number of nerve fibres probably exists, it has been included in the "normal" group. If this case is considered to be outside

Table I. *Number of myelinated fibres in the vestibular nerve of man*

Age	No.	Age	No.	Age	No.
1 day	18 773	49 yrs	16 582	75 yrs	15 980
6 wks	20 212	53 yrs	16 817	78 yrs	9 274
22 yrs	18 359			80 yrs	10 205
				80 yrs	10 074
35 yrs	16 040			85 yrs	12 000

the normal group an even earlier and greater reduction in fibre count than is reported here would be present.

The average number of nerve fibres for these four "normal" persons was 18 346.

The next 2 cases were aged 49 and 53 years and they were found to have an average number of 16 700 vestibular nerve fibres.

The last 5 cases were 75 to 85 years and a marked reduction of the number of nerve fibres was evident, their average number being only 11 506 fibres. The difference between the average values for the young and old-age groups is statistically significant at better than the 1% level.

DISCUSSION

Rasmussen (7) reported an average number of 18 500 fibres in the vestibular nerve. This study confirms his results for "normal" persons. The present study also shows that there is a clear reduction in number of nerve fibres with increasing age and in one case the vestibular nerve contained only 9 274 fibres, which is a very pronounced reduction. The average number of nerve fibres for the old-age group (75–85 years) is almost 40% lower than that for the young group (birth to 35 years). A reduction in number of nerve fibres with increasing age is found in all cases. However, in 1 case, aged 75, the vestibular nerve fibres were found to number 15 980, which is close to what has been regarded in this series, as a normal fibre content.

This study has only dealt with the number of fibres in the vestibular nerve. It is quite possible and indeed probable that the reduction of the number of nerve fibres is paralleled by a modification of the persisting ganglion cells and nerve fibres. Also, the 40% reduction found may be

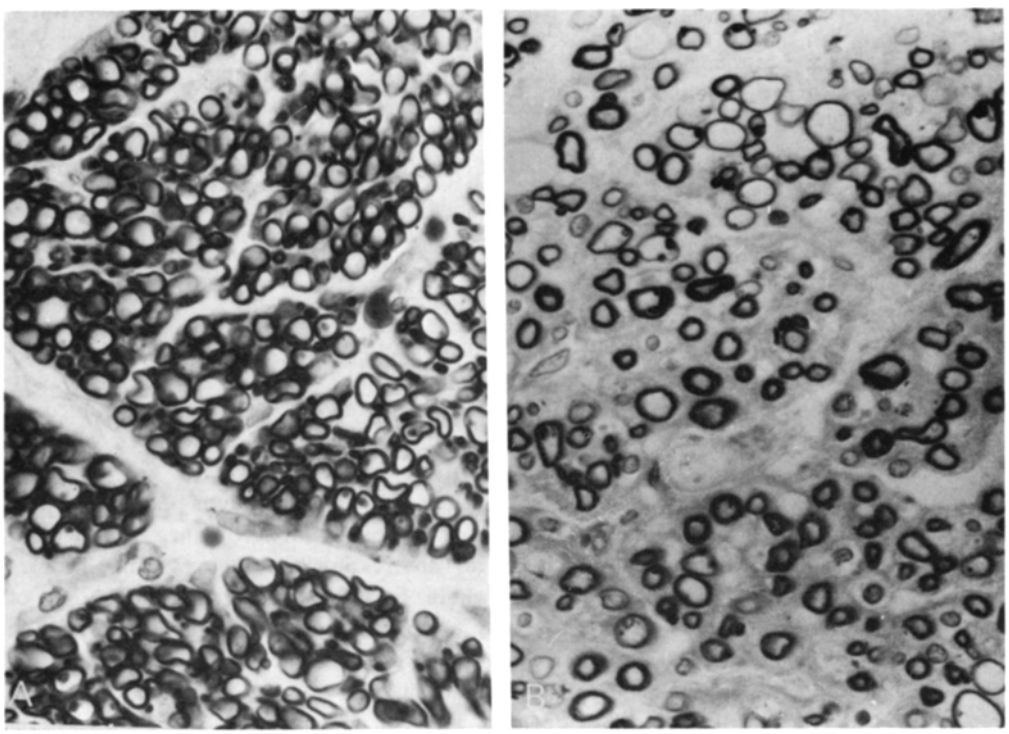

Fig. 1. Corresponding parts of the posterior ampullary nerve from a 6-week-old boy (*A*) and an 80-year-old woman (*B*). The reduction of the number of nerve fibres in old-age is evident. 550×.

only one parameter of the aging process of the vestibular nerve.

It has previously been stated that the cochlear nerve undergoes degeneration with increasing age. The term presbyacusis is widely used and many theories have been put forward concerning its aetiology. Therefore it is very interesting to note that the vestibular nerve undergoes a comparable degeneration with increasing age.

This report of a clear reduction of the number of vestibular nerve fibres with increasing age is in contradiction to earlier studies on the aging process in the vestibular system but conforms well with Rosenhall's (8) recent observations that the sensory cells also undergo a comparable reduction in number with increasing age.

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