PARALYSIS OF THE RECURRENT LARYNGEAL NERVE.

A Survey of 235 Cases.

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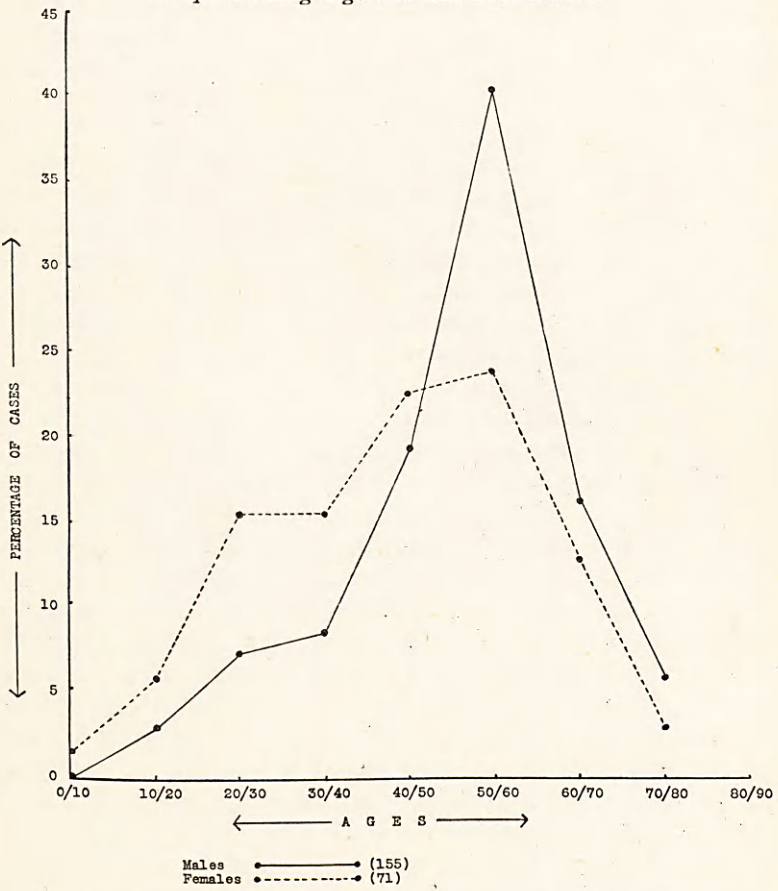
PARALYSIS of the recurrent laryngeal nerve has been widely studied from the clinical, anatomical and experimental standpoints, but statistical investigation of the problem appears to have been largely neglected. In text-books on the subject it is stated that paralysis of the left nerve is much more common than paralysis of the right, due to the longer course followed by the nerve on the left side, but until recently there have been few statistics available in support of this statement; also there is lack of statistical evidence in regard to the various causes of paralysis of the recurrent laryngeal nerve. Avellis[1] in a series of 150 cases was able to find the cause of the paralysis in only 85 of these. Recently New and Childrey,[2] in the *Archives of Otolaryngology*, gave a statistical summary of 217 cases where the cause was definitely known, and of a further 105 cases where no cause could be found.

The present investigation was first instituted in 1926 but was left unfinished, and an attempt has here been made to complete the work. The cases under consideration were under the charge of Dr Logan Turner and Dr J. S. Fraser in the Ear and Throat Department of the Royal Infirmary, and they have kindly permitted us to carry out this investigation.

Method of Procedure.—A total of 235 cases has been analysed, representing a period of 25 years, and it has been our endeavour to ascertain, so far as is possible, the history of these patients subsequent to their original examination in the Ear and Throat Department. This has been done either by writing to the patient and asking him to report at hospital or by writing to the doctor who recommended the case to hospital in the first place. Out of this total of 235 cases only 20 have been able to report at hospital for re-examination at the present time, but we have been able to obtain reliable information

regarding 48 others. Of these, 41 are dead, and 7 replied that they are in good health but unable to report at hospital. In the remainder of the cases no recent history was obtainable, but we have information regarding their condition on first attending hospital, and in a few of the cases there are, in

Graph showing Age and Sex Distribution.



addition, records of subsequent attendances. We would emphasise that cases in which some intrinsic condition of the larynx was present—for example, tuberculous or specific ulceration—have not been included in this series, because, though an ulcerative condition may affect the mobility of a vocal cord, it does not necessarily follow that the immobility is due to true paralysis of the recurrent nerve.

Sex Incidence.—Out of a total of 235 cases investigated, 162 were males and 73 were females, thus showing a preponderance of males over females of 2·2 to 1.

Age Incidence.—The accompanying graph shows the age and sex distribution of the cases examined. The number of cases at particular age groups has been expressed as a percentage of the total number of cases of each sex, and it is this percentage that is shown on the graph, not the actual number of cases. For example, in the age group 30 to 40, will be found 7 per cent. of all the male cases and 15 per cent. of all the female cases. It will be noted in the graph that up to the age of 40 the percentage number of female cases is almost double the percentage number of male cases. This is explained by the much greater prevalence of goitre in females. The comparatively larger percentage of male cases occurring at the age period 50 to 60 is due, at least in our series of cases, to the high incidence of aneurysm of the aorta and mediastinal tumour occurring at this particular age period.

Cause of the Paralysis.—In Table I. the various causes of the paralysis have been tabulated to show their frequency distribution in males and females. It should be stated, however, that the actual cause of the paralysis must, in some cases, remain a matter of conjecture, since we have no definite proof that the medical condition found on examination was the direct cause of the recurrent laryngeal nerve involvement. It will be noted from the table that in 23 cases no cause for the paralysis could be found despite careful examination, and in a further seven cases the paralysis was stated by the patient to have followed a "chill" or exposure to cold, and no other cause could be found for the paralysis. This group is of interest in that it raises the question of an "idiopathic" variety of paralysis similar to the familiar Bell's palsy affecting the facial nerve. In this connection, Fraser of Edinburgh[3] and Birkett of Montreal[4] have reported cases in which recurrent nerve paralysis has followed exposure to cold while motoring.

Forty-three cases were found to be due to disease of the cardio-vascular system and five of these were found to have a definite cardiac lesion without involvement of the aorta. It is believed by some that in mitral stenosis a dilated left auricle may cause paralysis of the left recurrent laryngeal nerve, though others are of the opinion that this is an anatomical impossibility.

Pulmonary tuberculosis accounts for 23 cases in the whole series. It must be observed that this number includes cases in which the lung involvement was not apical. It is usually thought that apical tuberculosis, as a cause of laryngeal paralysis,

TABLE I.

Showing Causes of the Paralysis.

Cause.	Cases.	Males.	Females.
Vascular. (43)			
Aneurysm of the aorta	34	29	5
Broadening of aortic arch	4	4	0
Heart disease	5	1	4
Respiratory. (25)			
Pulmonary tuberculosis	23	17	6
Acute pleurisy	1	1	0
Emphysema	1	1	0
Goitre. (30)			
Simple	7	1	6
Toxic	6	1	5
Malignant	5	2	3
Trauma at operation	12	3	9
Disease of Nervous System. (15)			
Bulbar paralysis	7	4	3
Tabes dorsalis	2	2	0
Amyotrophic lateral sclerosis	1	0	1
Progressive muscular atrophy	1	1	0
Post-diphtheritic	1	0	1
Spastic paraplegia	1	1	0
Hemiplegia	2	2	0
Tumours, etc. (50)			
Mediastinal tumour	27	21	6
Carcinoma of œsophagus	5	5	0
Enlarged glands in neck	18	14	4
Traumatic. (2)			
Wounds in neck	2	1	1
Following "Chill." (7)	7	7	0
No Cause Discovered. (23)	23	16	7
No Information. (40)	40	28	12
Totals	235	162	73

is more frequent in females than in males, although our figures show a preponderance in males. Furthermore, tuberculosis of the lungs is often regarded as the most common etiological factor in paralysis of the recurrent nerve in females. The figures in this series, however, show that goitre is a more

frequent cause than tuberculosis, and this may be partially explained by the fact that the diagnosis of goitre is more easily made than the diagnosis of pulmonary tuberculosis.

The largest number of cases occurs under the heading of tumours, and this includes mediastinal new growths of a benign as well as of a malignant nature. Enlarged glands in the neck accounted for 18 cases, and in some of these the glands were definitely malignant. In this connection it may be recalled that Logan Turner[5] drew attention to the occurrence of laryngeal paralysis from secondary glandular enlargement in malignant disease of the breast. In one of our cases paralysis of the left recurrent laryngeal nerve appeared to be the first sign of malignant disease of the stomach, where the left supra-clavicular glands had been invaded.

Included under the heading of disease of the nervous system in Table I. are two cases of hemiplegia. This condition has been mentioned, since its presence was noted in the case records when the patients first attended hospital. Since the movements of the vocal cords are controlled bilaterally in the cerebral cortex, it is usually considered that a unilateral lesion above the bulbar nuclei cannot cause laryngeal paralysis, and it is possible, therefore, that the association of the two conditions may have been a coincidence. In this connection, Brown Kelly[6] suggests that recurrent nerve paralysis associated with a cortical lesion is probably due to some undiscovered lesion of the nerve or muscles and not to the cortical lesion itself.

It will be noted in Tables II. and III. that the paralysis is bilateral in 23 cases or 9·8 per cent. of the total. New and Childrey's figures show a higher incidence of bilateral paralysis, namely 14·7 per cent. In their series, however, they included 6 bilateral cases due to tertiary syphilis of the larynx and 4 due to toxic neuritis, two conditions which do not occur in our investigation. If these 10 cases be excluded, the incidence of bilateral paralysis in New and Childrey's cases is reduced to 10·1 per cent., a figure which closely approximates to our own. It is not possible, with only 23 cases of bilateral paralysis, to draw any definite conclusion as to its cause. In the 15 cases of disease of the central nervous system in this series, the incidence of bilateral paralysis is high, as one would expect, but when the nerve involvement is of peripheral origin the tables do not reveal any one condition which predominates as a causative factor.

Recurrent Laryngeal Nerve Affected.—Tables II. and III. show the frequency of paralysis of the right and left nerve in males and females respectively. It will be noted from the tables

TABLE II.

Showing Cord Affected. (*Males.*)

Cause.	Cases.			
	Left.	Right.	Bilateral.	Total.
Aneurysm of aorta	23	2	4	29
Broadening of aortic arch	4	0	0	4
Goitre	3	4	0	7
Pulmonary tuberculosis	12	5	0	17
Mediastinal tumour	14	6	1	21
Enlarged glands in neck	8	6	0	14
Heart disease	1	0	0	1
Trauma	0	1	0	1
"Chill"	7	0	0	7
Tabes dorsalis	0	0	2	2
Spastic paraplegia	1	0	0	1
Progressive muscular atrophy	1	0	0	1
Lesion of œsophagus	4	0	1	5
Bulbar paralysis	1	0	3	4
Hemiplegia	2	0	0	2
Emphysema	0	0	1	1
Acute pleurisy	1	0	0	1
No cause discovered	11	4	1	16
No information	22	5	1	28
Totals	115	33	14	162

TABLE III.

Showing Cord Affected (*Females*).

Cause.	Cases.			
	Left.	Right.	Bilateral.	Total.
Aneurysm of aorta	4	1	0	5
Goitre	10	9	4	23
Pulmonary tuberculosis	2	4	0	6
Mediastinal tumour	5	0	1	6
Enlarged glands in neck	3	1	0	4
Heart disease	3	0	1	4
Trauma	1	0	0	1
Post-diphtheritic	1	0	0	1
Bulbar paralysis	1	0	2	3
Amyotrophic lateral sclerosis	0	0	1	1
No cause discovered	5	2	0	7
No information	10	2	0	12
Totals	45	19	9	73

that paralysis of the nerve on the left side occurs with much greater frequency, both in males and females, than paralysis of the right nerve. This is found to be true in all conditions, with the notable exception of goitre, where the right and left nerves are equally involved.

Cases in which Recovery Occurred.—Of the 20 cases which we have recently examined at hospital, 5 showed complete recovery from their former paralysis. In 4 of these cases no cause for the paralysis had ever been discovered. In the remaining case there was a positive Wassermann reaction and an enlarged descending aorta. Consideration of the 5 cases in which complete recovery occurred shows that 2 cases which were examined one year after they were first seen had completely recovered from a paralysed left cord, immobile in the cadaveric position, and a paralysed right cord immobile in the cadaveric position, respectively. Another case in which the left cord was immobile in the median line in 1927 was found to have completely recovered in 1932. The fourth case had complete paralysis of the left cord in 1920, though the position of the cord was not stated. In 1932 both cords were found to move freely. The fifth case, in which enlargement of the descending aorta was diagnosed, had paralysis of the left cord in 1929, which in 1932 had completely recovered. These cases serve to illustrate that paralysis of the vocal cord need not be regarded as invariably permanent, and also that recovery is more likely to occur in those cases in which no cause for the paralysis can be discovered.

Position of the Paralysed Vocal Cords.—The paralysed cord is usually stated by clinicians to be in one of two positions, namely the "cadaveric" or "median line." Sir Felix Semon,[7] towards the end of last century, expressed the view that paralysis of the recurrent laryngeal nerve was always primarily an abductor paralysis which subsequently became complete. This view has been raised to the dignity of a law, and is commonly referred to as Semon's Law. Many think, however, that Semon's Law has not been fully substantiated and towards the close of last century there was much fervid discussion on the question, notably by Grossmann of Vienna,[8] who did not agree with Semon's statements. In 1904, Saundby and Hewetson[9] published a case of carcinoma of the œsophagus with laryngeal paralysis in which the adductors were first affected, and this case has been universally regarded as an

exception to Semon's Law. In this connection it may be mentioned that Ferrier claimed that Semon's Law was only an expansion of his own law, that the extensors were more vulnerable than the flexors, while Negus[10] pointed out that the sphincteric muscle band served a vital function and is of more ancient origin than its antagonists, the dilators. Risien Russell has shown that the abductor and adductor filaments exist in the recurrent laryngeal nerves in separate bundles of fibres and it has also been experimentally demonstrated that the abductor fibres lose their conductivity more quickly than the adductor fibres. Semon's explanation of this difference in the conductivity was "a natural difference in the biological composition of the laryngeal muscles and nerve endings" and "similar differentiations in the nerve nuclei themselves." Herbert Tilley[11] in 1927 raised the question of fixation of the arytenoid joint and described nine cases of this condition which closely simulated paralysis of the recurrent laryngeal nerve. It is generally considered that primary fixation of the arytenoid joint is a rare occurrence. By Semon's Law, then, a paralysed cord in the early stage will be seen in the median line position, but later when the paralysis becomes complete, the cord moves outwards and occupies the cadaveric position. In this country few cases have been recorded in which a paralysed cord was found to have moved from the median line to the cadaveric position, and in our series only one such case was observed. Perhaps, if all cases of laryngeal nerve paralysis were more closely followed up after the first examination, a change from the median line to the cadaveric position might be more often seen.

Table IV. was compiled from the case records in which the position of the cord on first examination was given. It will be observed that this point was noted in only 117 cases out of the whole series. The table shows that when patients present themselves for first examination the paralysed cord in both sexes is most commonly found in the cadaveric position. Consideration of the 9 cases in this series, where the position of the affected cord was noted in the first instance and in which subsequent examination was carried out, reveals that in one case only the cord moved from the median line to the cadaveric position; in 4 cases the cord remained in the median line and in the remaining 4 cases the cord remained in the cadaveric position. Thus, in this series of 9 cases, in only one instance

was Semon's Law substantiated. A study of New and Childrey's figures reveals a preponderance of cases where the cord is in the median line position on first examination, and they point out that when all the muscles supplied by the recurrent laryngeal nerve are paralysed, there are still two muscles acting on the paralysed cord. These are the cricothyreoideus, which is supplied by the motor branch of the superior laryngeal nerve, and the arytenoideus, which receives fibres from both recurrent laryngeal nerves. It is their opinion that these muscles are

TABLE IV.

Showing Position of Paralysed Cord.

Cause.	Cases.					
	Median.		Cadaveric.		Total.	
	Male.	Female.	Male.	Female.	Male.	Female.
Aneurysm of aorta	2	1	11	2	13	3
Broadening of aortic arch	0	0	2	0	2	0
Goitre	3	6	1	6	4	12
Pulmonary tuberculosis	2	1	9	1	11	2
Mediastinal tumour	2	0	11	3	13	3
Enlarged glands in neck	3	0	3	2	6	2
Heart disease	0	0	1	3	1	3
Trauma	0	0	1	0	1	0
Post-diphtheritic	0	0	0	1	0	1
Chill	0	0	2	0	2	0
Lesion of œsophagus	0	0	2	0	2	0
Bulbar paralysis	0	0	0	1	0	1
Hemiplegia	1	0	0	0	1	0
No cause discovered	4	2	4	3	8	5
No information	4	3	13	1	17	4
Totals	21	13	60	23	81	36

sufficiently powerful to keep a completely paralysed cord in the median line and that every paralysed cord, therefore, eventually moves to the median line. In many of their cases the paralysed cord was found in the cadaveric position, and they offer the explanation that in these cases the superior laryngeal nerve was paralysed, as well as the recurrent nerve, from a lesion of the vagus at its exit from the skull. An examination of their table, however, reveals that most of the cases in which the cadaveric position was assumed by the affected cord were attributed to mediastinal lymph nodes and aortic aneurysm.

Our investigation leads us to believe that the cadaveric position is assumed by paralysed cords in the majority of cases,

and it seems difficult to conceive that a concurrent paralysis of the superior laryngeal nerve must be present to explain this observation. New and Childrey did not find one case in which a cord in the cadaveric position ever again become mobile, but in our series we have two cases which showed complete recovery.

Compensation.—Many of the cases which were examined showed evidence of an attempt on the part of the mobile cord to compensate the aphonia associated with the paralysed cord. A patient with one of his vocal cords immobile in the median line may suffer from slight dyspnœa but usually has little loss of voice. When, however, the paralysed cord is in the cadaveric position there is marked interference with phonation. In most of these cases the voice ultimately improves and practically all the patients we have examined stated that their voices had considerably improved since the aphonia first appeared. In one case, especially, the right cord was fixed in the cadaveric position, but the movements of the left cord extended well over the median line and the patient was able to sing fairly well. With regard to the length of time which must elapse before improvement can be expected, we believe that in the majority of cases considerable recovery of the voice occurs within one year of the occurrence of the paralysis.

Summary.

1. Paralysis of the recurrent laryngeal nerve occurs more frequently in males than in females, in the proportion of 2 to 1.

2. Paralysis of the left recurrent laryngeal nerve is of much more frequent occurrence than paralysis of the right nerve.

3. Goitre is the most frequent causal factor in paralysis of the recurrent laryngeal nerve in females and implicates the right nerve as often as the left.

4. The commonest causes of paralysis of the recurrent laryngeal nerve in males are aneurysm of the aorta and mediastinal tumour.

5. In the majority of cases, paralysis of the recurrent laryngeal nerve should be regarded as a grave sign, especially in males.

6. The majority of paralysed vocal cords observed in this study occupied the cadaveric position.

7. A paralysed vocal cord, irrespective of its position, may completely recover function. This occurs mainly in those cases in which no cause for the paralysis can be discovered.

8. The original aphonia resulting from a permanently paralysed vocal cord will ultimately show considerable improvement, and complete recovery of the voice may occur within one year.

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