

## Clinical and Experimental Studies of Labyrinthine Surgery for Vertigo

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There is no really satisfactory medical treatment for vertigo, because the causes of vertigo are many and varied. The majority of the causes of vertigo have been found to be peripheral in origin and located in the labyrinthine system. Among the vertigo caused by the peripheral vestibular system, Meniere's disease is the most frequent. Some of the other causes are positional nystagmus, vestibular neuronitis, drug poisoning and labyrinthine infection.

It is curious to observe that otologists on the one hand and neurosurgeons on the other hand have simultaneously been practicing ablation of the labyrinth or section of the acoustic nerve for the relief of vertigo (Dandy in 1928<sup>1)</sup>, Portmann in 1927<sup>2)</sup>). Since then Day in 1943<sup>3)</sup>, Cawthorne in 1943<sup>4)</sup> and Wright in 1938<sup>5)</sup> described the technique and the results of labyrinthine surgery.

Honjo in 1953<sup>6)</sup> reported an effective surgical method of labyrinthine surgery for vertigo following blow to the head.

Kido in 1961<sup>7)</sup> studied the effect of labyrinthine surgery. A series of 54 consecutive patients with vertigo was used in the study. Their ages ranged from 20 to 56 (average 43) years. 31 of 54 individuals were male and 23 were female. They were examined at our clinic between 1953 and 1956. All subjects were examined vestibular responses by means of caloric and rotatory tests before and after labyrinthine surgery. In the majority of patients (85 percent), about two weeks after surgery vestibular responses improved gradually.

Osaki in 1960<sup>8)</sup> carried out experimental study of vestibular response and histopathological finding after labyrinthine surgeries. Methods of surgery were 1. Cawthorne's operation, 2. Day's operation, Schucknecht's operation and Wright's operation. Fifteen healthy adult rabbits were used for each surgical technique. All animals were operated on the left sided labyrinth without exception. Results obtained by the above mentioned surgical techniques were compared with each other.

### 1. Cawthorne's operation.

During surgery, spontaneous nystagmus was present towards the right side (opposite side) in all animals but in one animal vertical nystagmus to upwards was present. After surgery, spontaneous nystagmus were seen in 13 of 15 animals, horizontal towards the opposite side, and were seen in 2 animals, vertical to upwards in nature. Head deviation to the operated side was seen in 12 of 15 animals.

Tonic labyrinthine reflexes were almost completely disturbed in all animals but only one animal was normal.

#### 2. Day's operation.

During surgery, in 11 of 15 animals spontaneous nystagmus towards the opposite side was present and the remainders showed vertical nystagmus to upward. After surgery, in the majority of animals (13 of 15) spontaneous nystagmus towards the opposite side was seen and in the remainders the nystagmus towards the operated side or oblique in nature was present. The head tilting to the operated side was seen in 11 of 15 animals and the remainders showed deviation of the head. Tonic labyrinthine reflexes were disturbed in 8 of 15 animals and were normal response in 6 of 15.

#### 3. Schuknecht's operation.

During surgery, in 5 of 15 animals spontaneous rotatory nystagmus towards the operated side was seen, in 3 of 15 animals spontaneous horizontal nystagmus towards the opposite side was present, and in 5 of 15 animals direction of the nystagmus was changed from the operated side to the opposite side during the procedure. After operation, the majority of animals (13 of 15) showed the nystagmus towards the opposite side and the remainders represented vertical nystagmus toward upward. The head was tilted towards the operated side in 12 of 15 animals and in 3 of 15 animals the head was held in normal position. Tonic labyrinthine reflexes was present normally in 6 of 15 animals and was disturbed in 9 of 15 animals.

#### 4. Wright's operation.

During surgery, in 6 of 15 animals vertical nystagmus was present, in 8 of 15 animals oblique nystagmus was seen, and in only 1 animal showed horizontal nystagmus towards the operated side. After operation, in 10 of 15 animals horizontal nystagmus towards the opposite side was seen, and in 5 of 15 animals vertical nystagmus toward upward was presented. As to the head position, there were various patterns. Tonic labyrinthine reflexes were normal in 8 of 15 animals and were disturbed in 6 of 15 animals except one uncertain.

#### 5. Histopathological findings in the vestibular labyrinth 5 days after

## Cawthorne's operation.

The crista ampullaris and cupula in the lateral semicircular canal were destroyed, in some animals the destruction of the utriculus was accompanied and degeneration of nerve fibers was present in all animals.

6. Histopathological findings in the vestibular labyrinth 7 days after Day's operation.

The content in the lateral semicircular canal was completely destroyed with degeneration of the nerve fibers.

7. Histopathological findings in the vestibular labyrinth 7 days after Schuknecht's operation.

The sacculus was destroyed completely.

8. Histopathological findings in the vestibular labyrinth 7 days after Wright's operation.

The vestibule, particularly the macula was destroyed.

9. Takahisa and Ogata in 1954<sup>9)</sup> carried out experimental study on vestibular response influenced by fenestration operation on the lateral semicircular canal. 51 healthy adult rabbits and 20 healthy adult guinea pigs were used.

Animal	During procedure of fenestration	When fenestration completes		
Rabbits 51	Nystagmus +20	Nystagmus +51	(Pause)	Nystagmus +22
	to operated side 3 to opposite side 17	to operated side 51 to opposite side 0		to operated side 6 to opposite side 16
	Nystagmus -31			Nystagmus -29
Guinea pigs 20	Nystagmus +2	Nystagmus +20	(Pause)	Nystagmus +3
	to operated side 2 to opposite side 0	to operated side 20 to opposite side 0		to operated side 2 to opposite side 1
	Nystagmus -18			Nystagmus -17

Fig. 1. Nystagmus due to the fenestration operation

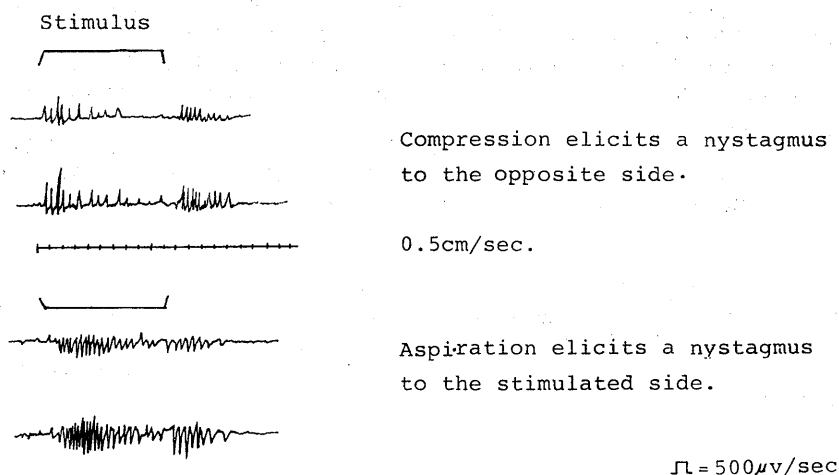
As shown in Fig. 1, during procedure of fenestration, that is while the bony capsula is cutting by means of dental but, spontaneous nystagmus was present in 20 of 51 rabbits. Of 20 rabbits, 3 gave the nystagmus towards the operated side and 17 gave the nystagmus towards the opposite side. When fenestration completes, that is the perilymphatic space is exposed, spontaneous nystagmus towards the operated side was present in all animals. After that, there was a pause lasting for about 10 seconds to a few minutes. Of 51 animals, nystagmus again occurred in 22 animals of which 6 animals gave the nystagmus towards the operated

side and 16 animals gave the nystagmus towards the opposite side. The remainders (29 animals) gave no nystagmus. During procedure of fenestration spontaneous nystagmus was present in 2 of guinea pigs. The direction of nystagmus was towards the operated side. When fenestration completes, spontaneous nystagmus towards the operated side was present in all animals. After that, there was a pause lasting for about 20 seconds. Of 20 animals, 3 gave nystagmus of which 2 animals gave the nystagmus towards the operated side and one animal gave the nystagmus towards the opposite side. The days after fenestration, postrotatory responses was disturbed in all animals (rabbits and guinea pigs), that is, frequency and duration of the postrotatory nystagmus decreased.

Miyahara and Hara in 1968<sup>10)</sup> carried out experimental study on the nystagmus induced by mechanical stimulation of the oval window. Fifty healthy adult rabbits were used. The stapes on the left side was removed in all animals. Constant pressures (positive and negative) of 40 and 80 mmHg were given to the oval window by means of a tip of small vinyl tube, 1.0 mm in diameter.

Positive pressure to the oval window induced nystagmus in 41 of 50 rabbits. Of 41 rabbits, 33 animals gave the nystagmus towards the opposite side, 4 animals gave the nystagmus towards the stimulated side, and 4 animals gave indefinite nystagmus. The remainders (9 animals) gave no nystagmus. Negative pressure to the oval window induced nystagmus in 41 of 47 rabbits. Of 41 animals, 31 animals gave the nystagmus towards the stimulated side, 4 animals gave the nystagmus towards the opposite side, and 6 animals gave indefinite nystagmus. The remainders (6 animals) gave no nystagmus.

Hara in 1970<sup>11)</sup> carried out experimental study on the nystagmus induced by mechanical stimulation of the oval window. 41 healthy adult rabbits were used in the study. The stapes was removed unilaterally in all animals. Constant pressure (positive and negative) of 40 mmHg was given to the oval window by means of a tip of small vinyl tube, 1 mm in diameter. All animals (41 rabbits) occurred nystagmus without exception. Compression and aspiration on both stimulations caused nystagmus in 31 of 41 rabbits and either of the two (compression and aspiration) elicited nystagmus in 10 of 41 rabbits. In 26 of 31 rabbits elicited nystagmus by compression and aspiration, compression caused a nystagmus in the direction of the opposite side and aspiration led to a nystagmus in the direction of the stimulated side as shown in Fig. 2. This represents an incidence of 64.3 percent in all animals. In 3 of 31 rabbits, compression and aspiration caused a nystagmus in direction of the stimulation side, in



one of 31 rabbits both stimulations led to a nystagmus in the direction of the opposite side, and in the remainder one rabbit compression caused a nystagmus towards the stimulated side and aspiration caused a nystagmus towards the opposite side. In 6 of 10 rabbits elicited nystagmus by either of the two stimulations, compression caused a nystagmus in the direction of the opposite side and aspiration led to no nystagmus and in the remainders (4 animals) aspiration led to a nystagmus in the direction of the stimulated side without nystagmus by compression.

In the great majority of animals, nystagmus represented horizontal in nature, and in a few animals rotatory and vertical nystagmus were seen. Duration of nystagmus elicited by mechanical stimulation ranged from 20 to 3 seconds and frequency of it was between 38 and 3.

### SUMMARY

In this paper, results obtained by clinical and experimental studies on labyrinthine surgery for vertigo which were carried out at our clinic for the past twenty years were reviewed.

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