

Cervical Trauma and Tinnitus

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Vestibulocochlear symptoms after cervical trauma remain a matter of controversy. This controversy is due to the difficulty in interpreting vague symptoms, the lack of objective findings, and the unpredictable time span between trauma and onset of symptoms.

Cervicogenic vestibulocochlear symptoms include vertigo, hearing loss, and tinnitus and frequently are used in the same context, suggesting a common mechanism. Experience with treatment, however, shows that symptoms respond quite differently and, generally, tinnitus is the least responsive.

Since 1978, we have been observing mydriasis in patients with vestibulocochlear symptoms. However, only recently a systematic investigation of this observation showed that mydriasis is associated with a functional disorder of the upper cervical spine and that it suggests sympathetic dysfunction. An analysis of 140 consecutive patients has shown that mydriasis frequently is found in C1-C2 facet joint disorders. In 81.5%, mydriasis is associated with ear symptoms. In our patients, whiplash injuries are represented in 58.3%.

We have become aware through the observation of mydriasis in C1-C2 facet joint disorders that the anterior cervical sympathetic plexus encompassing the superior cervical ganglion and the internal carotid artery nerve plays an important part in trauma patients, in contrast to the posterior cervical sympathetic plexus surrounding the vertebral artery (which has received all the attention in the past). These observations inspired us to carry out a pilot study to investigate the influence of the anterior cervical sympathetic plexus on tinnitus in patients with a history of whiplash injuries.

METHOD

Eight patients participated in this study. All had been assessed by a physiotherapist, and a C1-C2 facet joint disorder was confirmed. Previous conservative management of these patients' tinnitus was unsuccessful. Patients were

asked to complete a questionnaire. A reduction of tinnitus in excess of 30% was regarded as significant. A reduction of tinnitus of less than 30% was regarded as insignificant, as we were uncertain whether this represented a placebo effect. Three patients were treated with analgesia of the facet joints using 0.5% bupivacaine (Marcaine). Five patients were selected for superior cervical ganglion analgesia with buprenorphine (0.03 mg). Superior cervical ganglion analgesia was achieved through an oropharyngeal approach using a Sprotte cannula. After local anesthetic spray was applied to the posterior pharyngeal wall, the needle was directed against the paramedial pharynx by lifting the soft palate slightly and inserting the needle at an angle of 35-40 degrees against the sagittal plane. A guide prevented penetration of the needle beyond 1 cm. In all patients, pupil size was assessed with Frenzel glasses while the patient faced the observer first. Then each patient's shoulders were turned clockwise and counterclockwise by rotating the patient on a swivel chair while the head was secured in a forward position. Mydriasis was regarded as positive if change of the pupil size was observed immediately and showed a difference of at least 1 mm on a grid fixed on the outer glass of the Frenzel glasses.

RESULTS

After local anesthetic was applied to the facet joints, patients reported within 10 minutes that their tinnitus had diminished significantly. Simultaneously, mydriasis disappeared. In one patient, tinnitus was controlled completely. Tinnitus returned the next day in two patients but was still diminished in one. One patient mentioned that her tinnitus was less aggressive, and it remained so.

Following buprenorphine analgesia of the superior cervical ganglion, four of five patients responded with diminished tinnitus at an average decrease of 50%. One patient did not respond at all. The responders commented that their hearing had improved. None responded with complete control of tinnitus. The effect of tinnitus reduction lasted for several hours in two and for a couple of days in the other two patients.

DISCUSSION

The Barre-Lieou syndrome is regarded as the classic condition highlighting the relationship of cervical trauma and ear symptoms, such as fluctuating hearing, vertigo, and tinnitus. This syndrome also is called the *posterior cervical sympathetic syndrome*, emphasizing the importance of the sympathetic plexus surrounding the vertebral artery.

Typically, cervical trauma is seen as a result of automobile accidents that cause whiplash injury to the cervical spine. In the more traumatic rear-end collision, the mechanism is an exaggerated initial overextension followed by flexion of the cervical spine. The overextension causes a posterior subluxation of the cranial vertebrae, resulting in a narrowing of the intervertebral foramina and consequent pinching of the structures within [1]. These mechanisms strain the ligaments and facet joints and cause kinking and stretching of the vertebral artery.

Whereas these mechanisms help to explain symptoms as a function of irritation of the posterior sympathetic plexus surrounding the vertebral artery, one is not inclined to deduce from this mechanism irritation of the anterior sympathetic plexus comprising the superior cervical ganglion. Nonetheless, the clinical observation of mydriasis in these patients indicates involvement of

the anterior sympathetic plexus. This is supported by the effect of local anesthesia to the facet joints, particularly by the simultaneous abolition of mydriasis, which is controlled by postganglionic neurons originating from the superior cervical ganglion. The question remains of what constitutes the reflex mechanism.

In the past, providing evidence of the existence of preganglionic sympathetic fibers in the upper portion of the cervical spine that reached the superior cervical ganglion via C1–C2 spinal nerves was difficult. This would be the required anatomical basis to explain facet joint irritation with consequent activation of postganglionic sympathetic fibers of the superior cervical ganglion.

However, since the discovery of an independent intraspinal sympathetic pathway by Jansen and Loewy in 1997 [2], a new hypothetical reflex mechanism has now become available. Using a virus as a marker, these investigators found an independent intraspinal sympathetic pathway originating at C2 and stretching to T2, where preganglionic fibers leave the spinal chord to link up with the superior cervical ganglion.

The conceivable and hypothetical neuronal pathway would therefore encompass a sensory input from the facet joints at C1–C2, a C2–T2 intraspinal pathway, and preganglionic neurons that synapse in the superior cervical ganglion, followed by innervation of the iris and the cochlea by postganglionic neurons (Fig. 1).

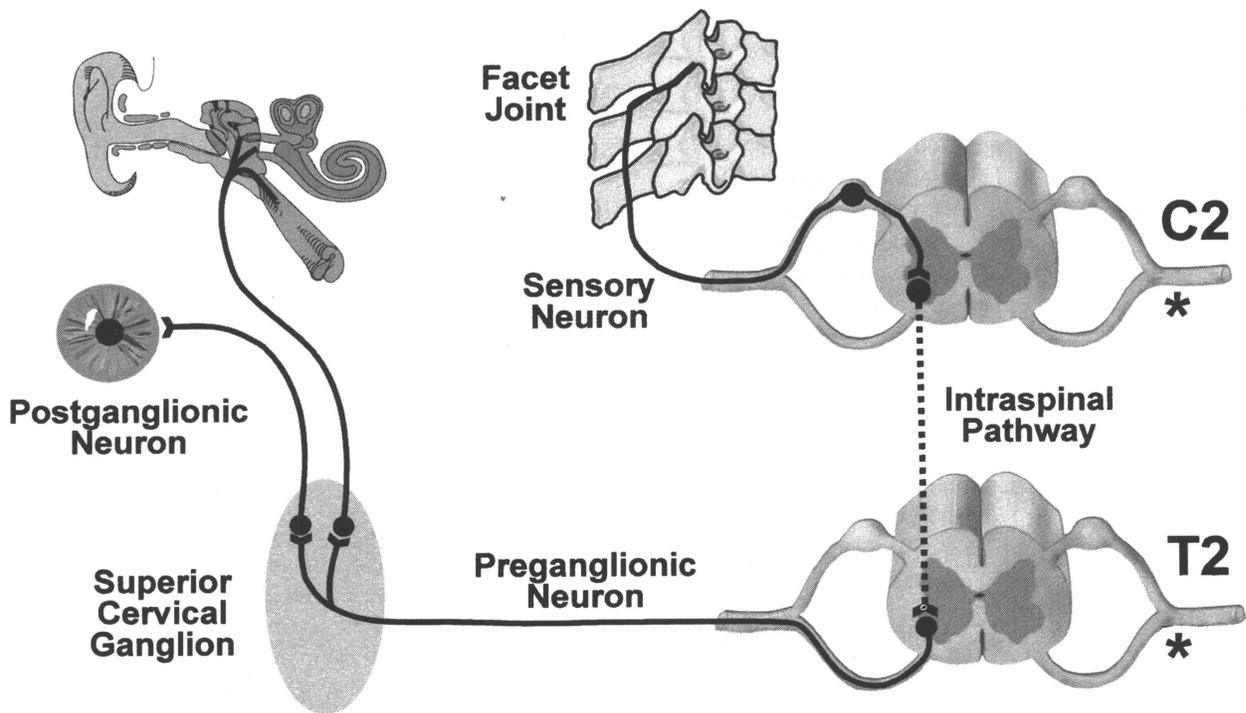


Figure 1. Hypothetical neuronal pathway in C1–C2 facet joint disorders.

Taking this neuronal pathway into consideration one would expect that interception at the superior cervical ganglion would have an effect comparable to facet joint analgesia. We decided to use buprenorphine for this purpose. A local anesthetic was not chosen, owing to the concern for possible complications from the superior cervical ganglion itself as well as from neighboring structures. Buprenorphine resulted in partial reduction of tinnitus.

Buprenorphine is an opioid that exerts its effect on μ -receptors. Opioids are becoming increasingly important as their impact on the auditory system gradually is recognized. In animal experiments, opioids have been demonstrated to reduce sensitivity of the superior cervical ganglion, an effect that is achieved through inhibition of ganglionic transmission, possibly at postsynaptic opioid receptors [3]. Our initial clinical experience and the effect of buprenorphine analgesia of the superior cervical ganglion seems to support this mechanism in humans. However, further experience is required, particularly regarding the selection of the appropriate opioid, the dosage, and the best technique of administration.

CONCLUSION

Tinnitus can temporarily be reduced by the application of local anesthetic to C1–C2 facet joints and buprenorphine analgesia of the superior cervical ganglion in patients with C1–C2 facet joint disorders. C1–C2 facet joint disorders not only might lead to irritation of the posterior cervical sympathetic plexus but also could irritate the anterior cervical sympathetic plexus. These findings must be taken into consideration by those physicians managing patients with cervical trauma and tinnitus.

REFERENCES

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