HEMANGIOMA OF THE FACIAL NERVE: ROLE OF THE GENICULATE CAPILLARY PLEXUS

Abstract—Hemangioma of the facial nerve may occur more frequently than previously recognized. This benign vascular tumor most often arises in the area of the geniculate ganglion, although the reason for this site of predilection is not known. Using silicon injection and cross-sectional vessel counts, we recently demonstrated the presence of a geniculate capillary plexus (GCP) in the cat. The present study was designed to identify a similar GCP in man, if present, and to relate it to the site of predilection of hemangioma of the facial nerve. Twenty-five human facial nerves were studied in horizontally sectioned temporal bones. A clinical case of hemangioma arising at the geniculate ganglion is presented. The human geniculate ganglion has a very rich capillary plexus in contrast to the poor intrinsic vasculature of the adjacent labyrinthine segment and moderate vasculature of the tympanic segment of the facial nerve. We hypothesize that the GCP is the origin of most hemangiomas of facial nerve. The anatomic distinctness of the geniculate ganglion and GCP from the facial nerve may allow removal of these tumors with preservation of motor function in certain cases.

Hemangioma of the facial nerve, once thought to be extremely rare, has recently been shown to occur more commonly.¹⁻⁵ The terms “hemangioma” and “benign vascular tumor” are used synonymously. They may be subclassified by their predominant histologic appearance, such as capillary, venous, arteriovenous, and cavernous. Hemangiomas may invade bony trabecula or may form intratumoral bony spicules. The latter have been termed ossifying hemangiomas.

Although hemangiomas of the facial nerve have been known to occur most commonly at the geniculate ganglion,^{1,4-6} the reason for this site of predilection is not known. Based on our previous cat facial nerve studies,⁷ which showed a highly vascular geniculate capillary plexus (GCP), we hypothesize that a similar vascular plexus of the geniculate ganglion may occur in man and that it may be the reason for this site of predilection for

benign vascular tumors. Fisch and Ruttner¹ previously suspected that this site of predilection corresponded to an area of vascular anastomosis.

In our previous study, we evaluated 28 fresh cat facial nerves by silicon injection and tissue clearing, along with vessel counts on serial cross-sections of individual nerves.⁷ Serial vessel counts clearly demonstrated quantitative differences in the intrinsic vasculature among the three segments of the facial nerve. In addition, a high density of capillaries in the geniculate ganglion, the GCP, was identified. The relative scarcity of intrinsic vessels in the labyrinthine segment, proximal to the geniculate ganglion, was also striking. Figure 1 is typical of findings in 12 cat facial nerves following arterial perfusion with fast-hardening silicone (Microphil). Note the anatomic distinctness of the GCP from the facial nerve.

Figure 1. Cat facial nerve following intravital injection of fast-hardening silicone (Microfil) and tissue clearing. Note the high vascular density and anatomic distinctness of the GCP from the adjacent nerve. TS: tympanic segment; GG: geniculate ganglion; GPn: greater petrosal nerve; LS: labyrinthine segment.

MATERIALS AND METHODS

Twenty-five human temporal bones from the University of Colorado Department of Otolaryngology-Head and Neck Surgery collection were selected for study according to the following criteria:

1. No history of temporal bone disease
2. No systemic disease that may affect the temporal bone
3. No congenital disease of any kind
4. Adequate sections of all labyrinthine and tympanic segments along with the geniculate ganglion available for study

All temporal bones had previously been fixed in 10% formalin, progressively dehydrated in ethanol at room temperature, imbedded in celloidan, and sectioned horizontally at 20 μ m. Every tenth section was stained with hematoxylin and eosin (H & E).

For each of the 25 nerves studied, an average of three representative sections of each segment was selected from the labyrinthine segment (just proximal to the geniculate ganglion), the geniculate ganglion (Fig. 2), and the tympanic segment (just distal to the geniculate ganglion).

Intrinsic vessel counts were performed under $\times 100$ fields. Enlarged pictures were drawn of each slide. Area-density functions were then compared. Vessels were counted

only when endothelial nuclei were clearly and definitively identified. Vessels in the surrounding connective tissue were not included.

Differences between intrinsic capillary densities of the three tested facial nerve segments were statistically analyzed with the paired *t* test using the SPSS software program.

RESULTS

A total of 563 capillaries were detected in 66 sections of the geniculate ganglion from 25 human facial nerves. The mean capillary density was 8.5 per field. Also, 152 capillaries were detected in the tympanic segment (mean density, 2.3 per field), and 100 capillaries were detected in the labyrinthine segment (mean density, 1.5 per field).

The difference between geniculate and tympanic is statistically different, with a *t* value of 7.38 at $p < 0.001$. Geniculate and tympanic are not correlated with a Pearson product moment correlation of 0.021 at $p < 0.10$.

The difference between geniculate and labyrinthine is statistically different, with a *t* value of 9.79 at $p < 0.001$. Geniculate and labyrinthine are correlated with a Pearson product moment correlation of 0.428 at $p < 0.05$. The correlation implies that the higher the geniculate score the higher the labyrinthine score.

Figure 2. Human geniculate ganglion. Large arrow is at ganglion cell, and small arrows are at capillaries. (H&E; original magnification, $\times 100$.)

The difference between tympanic and labyrinthine is statistically different, with a t value of 2.42 at $p < 0.05$. Tympanic and labyrinthine are not correlated with a Pearson product moment correlation of 0.245 at $p < 0.10$.

CASE REPORT

A 41-year-old man was referred by his neurologist for evaluation of "left Bell's palsy" of 5 months' duration. Paralysis was complete approximately 4 days after onset. There was no history of pain or facial twitching and the patient did not respond to two courses of oral steroids.

On examination, peripheral-type facial paralysis was complete and tearing in the right eye was reduced. Facial electroneurography showed a 95% denervation on the right. Pure-tone speech and auditory brainstem response audiometry were normal. Computed tomography (CT) examination was normal. Transmastoid exploration was normal but middle fossa exploration demonstrated a soft red mass overlying the geniculate ganglion. A frozen section biopsy demonstrated benign vascular tumor. Further bony removal permitted excision of this 0.9×0.6 cm soft tissue mass along with its origin at the geniculate ganglion without resection of the facial nerve. Approximately 6 months later facial tone improved and voluntary movement began to return. The patient has good voluntary movement with moderate synkinesis 2 years post-operatively (grade III/VI).

Pathologic sections demonstrate a central cluster of compact large vascular channels containing blood and

lined with small well-differentiated endothelial cells. The walls were thick and fibrous with spindle-shaped nuclei. Particles of calcium were seen interspersed in the lesion (Fig. 3)

DISCUSSION

The presence of a dense capillary plexus within the geniculate ganglion is evident from study of both the cat and man. The technique used in the current study has certain inherent shortcomings due to the limitations of horizontal sectioning. However, intravital perfusion of silicone, which confirmed the cross-sectional vessel counts in the cat, is not feasible in man. In spite of the limitations of technique, we believe that vessel counts alone are adequate to confirm in man the previous findings demonstrated by more exhaustive techniques in the cat model. The paucity of intrinsic vessels in the labyrinthine segment of the facial nerve may have implications in other facial nerve disorders and will be the subject of a separate article.

Clinical differentiation of facial paralysis between Bell's palsy and tumor is sometimes difficult. In this case the typical slow progression of paralysis or recurrent paralysis did not occur. The typical CT imaging findings of benign vascular tumor of the facial nerve have been well described.⁴⁻⁶ Lo et al⁴ reported CT findings in 11 cases and noted enlargement of the facial nerve canals with irregular margins and a honeycomb appearance. The average age of these patients was 24 to 51 years and the tumors

Figure 3. Hemangioma of the facial nerve. Arrow is at geniculate ganglion. (H&E; original magnification, $\times 200$).

occurred most commonly at the geniculate ganglion. Cutrin et al⁵ reported on six patients, all women, ranging in age from 25 to 55 years of age. The symptoms had been present an average of 2 years or more and had been slowly progressive or recurrent in all cases. They also noted the typical CT lesion of an enlarged facial nerve canal with intratumoral bone spicules and indistinct margins. They note that these findings make the diagnosis of hemangioma much more likely than schwannoma. Although meningiomas may have intratumoral bone as well, it is generally more dense. Bone within the tumor takes on a honeycomb appearance and has led Fisch and Ruttner¹ to use the term "ossifying hemangioma." The absence of CT findings in this case may be due to the relatively small size of the tumor.

Cutrin et al⁵ report that the major portion of the tumor found at surgery is anterior and superior to the fallopian canal, just as was found in our patient. In four of six of their cases the authors attempted to preserve the integrity of the facial nerve while removing the hemangioma and geniculate ganglion. They were able to do so in three of those four cases.

As noted, early radiographic diagnosis may be important in management of these cases, since the usually small tumors cause early paralysis. Small vascular tumors tend to produce neural deficits that might be expected from a much larger facial neurilemmoma. Other common benign tumors in the geniculate ganglion region include neurilemmomas⁸ and congenital epidermoids.⁹ Congenital epidermoids generally have very sharp bony margins but may contain calcific stippling.

In the internal auditory canal benign vascular tumors

ing (MRI)⁴. Unfortunately, MRI has not been effective in imaging small tumors along the facial nerve.

The importance of early diagnosis lies in the origin of these tumors, usually from the geniculate ganglion. In the case described and in those described by Cutrin et al⁵ the geniculate ganglion and vascular tumor may be removed with preservation of facial nerve continuity if operated on early. This is in distinction to facial neurilemmoma, which grows concentrically around the nerve and removal of which requires resection of a segment of the facial nerve. Thus, while the deficit caused by removal of neurilemmomas is great enough to cause a prudent delay in surgery, or even simple decompression in some cases, early resection of benign vascular tumors offers the best chance for good facial nerve recovery.^{2,6}

Figure 1 shows the rich capillary plexus within the geniculate ganglion as well as the anatomic distinctness of the ganglion from the motor neurons of the facial nerve. Because of the anterior and superior positioning of the geniculate ganglion, the bulk of these tumors tends to be accessible through the middle cranial fossa and in some cases may be removed without disturbing the motor neurons.

CONCLUSIONS

Benign vascular tumors or hemangiomas occur more frequently along the facial nerve than previously recognized. They most commonly arise from the geniculate ganglion. Small vascular tumors cause neural deficits greater than those one would expect from their size. A typical imaging picture of these lesions has been devel-

oped and facial paralysis, not typical of Bell's palsy, should be evaluated for a lesion at the geniculate ganglion with both MRI and CT. Early diagnosis provides the best chance of functional recovery because removal of these tumors, along with the geniculate ganglion, with preservation of motor nerve fibers may be possible in certain lesions. A geniculate capillary plexus has been demonstrated in man.

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