

## Hemorrhagic Vestibular Schwannoma: Review of the Literature

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### Key words

- Acoustic neuroma
- Intratumoral hemorrhage
- Vestibular schwannoma

### Abbreviations and Acronyms

**CN:** Cranial nerve  
**ITH:** Intratumoral hemorrhage  
**MRI:** Magnetic resonance imaging  
**SRS:** Stereotactic radiosurgery  
**VS:** Vestibular schwannomas



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### INTRODUCTION

Vestibular schwannomas (VS) are benign neoplasms of cranial nerve (CN) VIII that most commonly arise from the superior vestibular portion of the nerve, at the Obersteiner-Redlich transition zone. Approximately 5% of cases are associated with type 2 neurofibromatosis. VS account for 8%–10% of all intracranial tumors (21) and approximately 75% of cerebellopontine angle tumors (1). These tumors have various clinical presentations, ranging from dormancy for many years without sequelae to sudden and acute hearing loss, tinnitus, gait ataxia, and vertigo (1, 2, 5). According to a study of 1000 VS cases, cochlear nerve impairment occurs in 95% of cases, vestibular nerve impairment occurs in 61%, trigeminal nerve impairment occurs in 17%, and facial nerve involvement occurs in 6% (16). Intracranial hemorrhage occurs in 11% of all brain tumors, but hemorrhage associated with VS historically has been noted in <1% of cases (1, 4). Since the initial report of intratumoral hemorrhage (ITH) in VS by McCoyd et al. in 1974 (17), >50 cases of hemorrhagic VS have been reported in the literature in the form of case reports and small case series. However,

■ **BACKGROUND:** Clinically significant intratumoral hemorrhage historically has been reported in only a small fraction of vestibular schwannomas (VS). Patients with hemorrhagic VS are more likely to present with neurologic deficits and have worse outcomes than patients with nonhemorrhagic VS. The purpose of this study is to analyze characteristics that may predispose VS to hemorrhage and that may prove helpful in the management and treatment of VS.

■ **METHODS:** A literature search was conducted using National Library of Medicine and National Institutes of Health databases to identify articles pertaining to intratumoral hemorrhage in VS. The authors selected 39 cases, described in 18 published articles, to review.

■ **RESULTS:** Average patient age and tumor size in hemorrhagic cases of VS did not differ significantly from nonhemorrhagic cases of VS. Facial nerve dysfunction at presentation occurred with greater frequency in cases of hemorrhagic VS (33.3%) than in nonhemorrhagic VS (6.0%). Death occurred much more frequently in cases of hemorrhagic VS (10.0%) than in nonhemorrhagic VS (0.2%). Abnormality of tumor-associated vasculature was noted histologically in many cases, and a large number of the cases reported prior treatment by stereotactic radiosurgery.

■ **CONCLUSIONS:** Understanding the origins and clinical implications of intratumoral hemorrhage in VS could potentially assist in clinical decision making and patient counseling.

advances in imaging and larger analyses suggest that ITH is far more common than previously believed and might represent an aspect of the natural history of VS. Hemorrhagic VS often manifests with acute onset of symptoms and has been inadequately studied since McCoyd's initial description (3, 13, 24). Treatment options for hemorrhagic VS are no different than treatment options for nonhemorrhagic VS, including observation, surgical resection, and stereotactic radiosurgery (SRS), each depending on urgency of the situation (10, 15). We provide a comprehensive review of recent literature reporting ITH in VS and describe the characteristics of its clinical manifestation.

### METHODS

Databases of the U.S. National Library of Medicine and the National Institutes of Health (PubMed) were queried to identify all studies describing ITH in VS. "Intratumoral hemorrhage" was defined as evidence of

bleeding within a vestibular schwannoma. Key terms used in the search included "hemorrhage," "acoustic neuroma," and "vestibular schwannoma." Using these search parameters, 12 English-language articles were discovered. Pertinent references cited in these articles were also examined (2, 3, 11, 14, 27, 29). To gather cases that represented the inception of magnetic resonance imaging (MRI), only reports published after 1990 were included in our review. Our analyses comprised 18 articles yielding a total of 39 cases. When cases failed to report data for a given category, they were not included in the pool of data from which percentages were calculated.

### RESULTS

We analyzed 39 cases of ITH in VS for comprehensive review. The case reports are summarized in Table 1. Average age at presentation with hemorrhagic VS was 51.3 years  $\pm$  15.8 (range, 19–73 years).

**Table 1.** Case Reports of Intratumoral Hemorrhage into Vestibular Schwannoma Published After 1990

Author, Year	Age (years), Sex	Size (largest dimension, cm)	Side	Clinical Presentation	T1 (if present)	T2 (if present)	Bleed Type	Treatment	Outcome
Asari et al., 1992 (1)	45, F	3.8	NR	HL, headache	Hyperintense	Hyperintense	Late subacute	Surgery NS	Good
	31, M	2.8	L	Headache, CN V palsy	Hyperintense	Hyperintense	Late subacute	Surgery NS	Good
	63, F	3	NR	HL, tinnitus	Hyperintense	Hyperintense	Late subacute	Surgery NS	Good
	54, M	3	NR	HL, headache, tinnitus	Hyperintense	Hyperintense	Late subacute	Surgery NS	Good
Benhaiem-Sigaux et al., 1999 (2)	55, M	1.6	R	HL, nausea, dizziness	Hypointense	Hypointense	Chronic	TL	Good
Brady & Stack, 1994 (3)	70, M	"Large"	NR	HL, CN VII palsy, headache, nausea, vomiting	NR	NR	NR	Surgery NS	Good
	64, F	NR	R	HL, gait disturbance	Hypointense	Hyperintense	Early subacute	Surgery NS	NR
Carlson et al., 2010 (4)	66, M	2	L	HL, CN VII palsy	Hyperintense	Hypointense	Early subacute	RS	CN VII palsy
Chou et al., 1998 (6)	36, M	2	L	HL	NR	NR	NR	RS	Good
Dehdashti et al., 2009 (7)	41, F	1.6	NR	HL	NR	NR	NR	RS	Good
	47, F	3.6	L	Headache, gait disturbance	NR	NR	NR	TL (prior SRS)	Good
	48, F	3	NR	Headache, nausea, CN V palsy	NR	NR	NR	RS	Good
	66, M	2.3	NR	Headache	NR	NR	NR	Surgery NS	Death
	26, F	4	L	Headache, dizziness, nausea	NR	NR	NR	RS	Good
	68, M	1.8	NR	Headache, CN VII palsy	NR	NR	NR	RS	Good
Karampelas et al., 2007 (10)	55, M	2	R	HL, CN VII palsy	NR	NR	NR	SRS	Good
Kim et al., 1998 (11)	35, F	4	L	HL, headache, tinnitus, dizziness, gait disturbance	Hyperintense	Hyperintense	Late subacute	Surgery NS	Good
Lessin & Alenghat, 1993 (14)	68, M	3.5	L	HL, CN VII palsy, CN V palsy	NR	NR	NR	RS	NR
Mandl et al., 2009 (15)	59, F	9.6 cm <sup>3*</sup>	L	HL	NR	NR	NR	RS	CN VII palsy
Misra et al., 1995 (18)	35, F	4.2	NR	NR	NR	NR	NR	Surgery NS	Death
	30, F	4	NR	NR	NR	NR	NR	RS	Good
	32, M	6	NR	NR	NR	NR	NR	RS	Good
	43, F	5	L	NR	NR	NR	NR	RS	Good
	65, F	3	NR	NR	NR	NR	NR	RS	Good
	72, M	3.8	NR	NR	NR	NR	NR	RS	Good
	44, F	5.2	NR	NR	NR	NR	NR	RS	Good

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