Surgical and Radiation Therapy in Sinonasal Schwannoma with Infratemporal Fossa Involvement

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Abstrak

Latar belakang: Schwannoma adalah tumor jinak yang berasal dari sel Schwann pada lapisan pembungkus saraf perifer. Schwannoma pada kavum nasi dan sinus paranasal sangat jarang terjadi. Gejala yang ditimbulkan tidak spesifik seperti sumbatan hidung, epistaksis dan anosmia. Penatalaksanaan schwannoma pada sinonasal adalah dengan terapi konservatif berupa tindakan pembedahan reseksi tumor dan memberikanprognosis baik.**Tujuan*:*** Mengingatkan bagaimana membuat diagnosis dan tatalaksana schwannoma sinonasal dengan keterlibatan fosa infratemporal secara komprehensif. **Kasus:**Dilaporkan satu kasus schwannoma sinonasalpada fosa infratemporal terhadapseorang wanita berusia 38 tahun. Diagnosis berdasarkan anamnesis, pemeriksaan fisik dan pemeriksaan penunjang yang lengkap. **Penatalaksanaan:**Kasus tersebut ditatalaksana dengan pembedahan dan radiasi.**Kesimpulan:** Schwannoma sinonasal dengan keterlibatan fosa infatemporal yang tidak dapat ditatalaksana dengan bedah seluruhnya dilanjutkan dengan pemberian radiasi.

Kata kunci: Schwannoma, neurilemma, sinonasal,

Abstract

Background:*Schwannoma are benign tumor arising from Schwann cells of the peripheral nerve sheath. Its occurance in the nasal cavity and paranasal sinuses is extremely rare. Clinical symptoms were nonspecific (nasal obstruction, epistaxis, and anosmia). Sinonasal schwannomas are treated with conservative surgical resection and have an excellent prognosis.**Objective:**How to make comprehensive diagnosis of sinonasal schwannoma with infratemporal involvement and the consideration of surgical and radiation therapy**Case:**One case of sinonasal schwannoma with infratemporal fossa involvement in a 38-year-old woman, she underwent diagnosis thorough history, and complete medical examinations**Management:** This patient underwent surgical and radiation therapy. **Conclusion:**Sinonasal schwannoma with infratemporal fossa involvement which cannotcompleted surgicallymanaged was given radiation therapy.*

Keywords: Schwannoma, neurilemma, sinonasal

INTRODUCTION

Schwannoma is a neurogenic tumor arising from the Schwann cells of the sheath of myelinated nerves. This is a rare neoplasm that can be found in any part of the body. The neck and head region is the most frequently observed region of schwannomas; accounting for 25% to 45% of all cases. The scalp, face oral cavity, tongue soft palate, pharynx and parapharyngeal space, larynx, trachea, parotid gland, middle ear, internal and external auditory meatus, and neck are less frequently involved. Only 4% of these head and neck lesions involve the nasal cavity and paranasal sinuses. Within this location,the ethmoidal sinus is most commonly involved, followed by the maxillary sinus, nasal fossa, and sphenoid sinus. Frontal sinus involvement extremely rare and there are only a few reported cases.[1-4]

Schwannomadeveloping in the nasal cavity and paranasal sinuses are known to originate from the ophthalmic branch and maxillary branch of trigeminal nerve or parasympathetic nerve, which originates from sphenopalatine ganglion and sympathetic nerve originating from the carotid nerve plexus.[3]

Sinonasal schwannoma do not have specific radiologic findings. The tumor rarely extends intacranially or intraorbitally, imaging features can be similar to malign neoplasms.[3]

This case report remind us how to make comprehensive diagnosis and management of schwannoma in sinonasal with infratemporal fossa involvement.

ANATOMY

The peripheral nervous system consists of nervous tissue outside of the brain and spinal cord and includes somatic and autonomic nerves, end-organ receptors, and supporting structures. It develops when axons lying close to one another grow out from the neural tube and are gradually invested with Schwann cells. Schwann cells arise from the neural crest, a group of cells that arise from and lie lateral to the neural tube and underneath the ectoderm of the developing embryo.

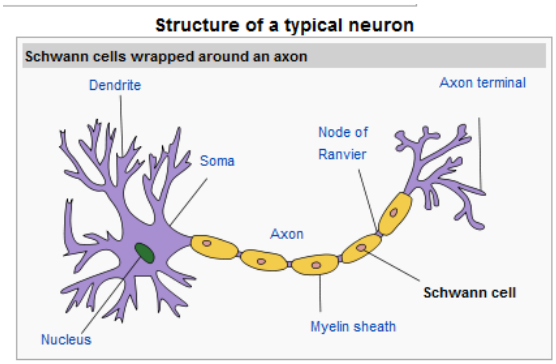
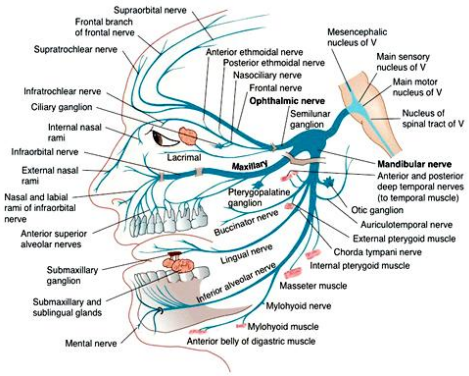


Figure 1. Neuron

The major peripheral nerve trunks form by fusion and division of segmental spinal nerves and contain mixtures of sensory, motor, and autonomic elements.[2]

In the fully developed nerve, a layer of connective tissue or epineurium surrounds the entire nerve trunk. This structure varies in size, depending on the location of the nerve, and it is composed of a mixture of collagen and elastic fibers along with mast cells. Several nerve

fascicles lie within the confines of the epineurium, and each, in turn, is surrounded by a well-defined sheath known as the perineurium. The outer portion of the perineurium consists of layers of connective tissue, and the inner portion is represented by a multilayered, concentrically arranged sheath of flattened cells. The perineurium, which is continuous with the pia-arachnoid of the central nervous system, represents the principal diffusion barrier for the peripheral nerve.[1-2]



EPIDEMIOLOGY

This tumour has been reported to affect both genders equally with mean age of presentation between 20 and 50 years old. Nevertheless, there are reported cases in the young and elderly.[4]

At Rigshospitalet in Copenhagen, Denmark,have diagnosed five cases of nasal or paranasal schwannomas over the last 25 years.[4]

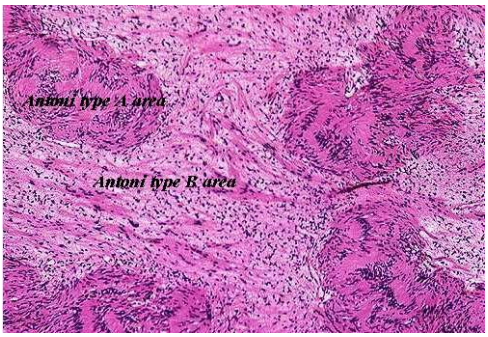
In a 1975 review of American and European literature, Robitaille et al found only 24 cases of schwannomas in the sinonasal tract. Specifically, 10 cases were in the antrum, eight were in the ethmoidal sinus, five were in the nasal cavity, one was in the sphenoid sinus.

HISTOLOGIC

Schwannomas are usually described as being encapsulated. The capsule is assumed to derive from the perineuriumof the nerve of origin. Some authors speculate that sinonasal mucosal autonomic nervous system fibers aredevoid of perineural cells and, therefore, lack encapsulation. Encapsulation of schwannomas in this region is rare,which probably explains the rather aggressive growth pattern compared with schwannomas in other locations. Thelack of encapsulation might make the tumor more difficult to define and extract completely.[5]

Verocay described the histological aspects of the schwannoma already in the early 1900s, with the characteristic feature of the palisading cell arrangement, also called "Verocay bodies". Macroscopically the tumour is usually well demarcated, grayish to yellowish in colour, fleshy and shiny on the surface. Microscopically, it typically consists of cellular areas (Antoni type A) with spindle-shaped cells often arranged in palisades, together with more loosely structured areas with a myxoid stroma (Antoni type B). Type A tissue is compactand solid and its cells are set in orderly arrangement. TypeB tissue is loosely textured, reticulate, patternless and oedematous. Criteria in favor of malignancy are markedcytonuclear atypia, tumor necrosis, and a high

proliferationindex (>5 mitoses/20 HPF) with abnormal mitoses. The decreased expression of S100 protein by tumor cells is another argument for malignancy.[7-8]



Histologically, five variants of schwannomas have been describe, namely, common, plexyform, cellular, epitheloid, and ancient schwannoma. Some tumors may contain cysts or exhibit other degenerative phenomena; if the tumours are accompanied by a significant nuclear pleomorphism, the term 'ancient schwannoma' may be applied.

DIAGNOSTIC

Clinical Findings

The clinical presentation of sinonasal schwannoma varies and depend on the site and the extent of the tumour. The clinical symptom of a schwannoma can be hypoesthesia or paresthesia that is caused by the compression of the involved nerve by the tumor. In cases involving the nasal cavity or the paranasal sinuses, nonspecific symptoms include nasal obstruction, nasal discharge, facial pain and headache. The most common symptoms associated with sinonasal schwannomas are unilateral nasal obstruction, epistaxis, hyposmia and pain. Exophthalmus, facial swelling and epiphora have also been reported but to a lesser degree. Ethmoid sinus and nasal cavity tumors frequently present with epistaxis, whereas tumors of the maxillary sinus are usually associated with pain. Most patients with schwannoma present late to the hospital. This is mainly due to the similarities of their symptoms with that of other benign sinonasal conditions such as allergic rhinitis, chronic rhinosinusitis and nasal polyps. This results in delay in reaching the correct diagnosis in some of the cases. Because there are usually no distinctive clinical features to be noted during clinical examination; the diagnosis can only be made after histological examination.[11-14]

Histologic Findings

Histopathological examination of the tumor tissues is always warranted for the diagnosis of schwannomas.

The positive staining for S-100 is specific for Schwann cells and is one of the histological criteria used for diagnosis of schwannoma. Even though this tumour is considered benign, it has a potential to become malignant. Histologically, the malignant potential of this tumour can be predicted based on the presence of an unequivocal malignant foci manifested by increased cellularity, numerous mitoses, anaplastic cells, and invasiveness.[5-7]

Radiologic findings

Sinonasal schwannomas do not have specific radiologic findings. The tumor rarely extends intracranially or intraorbitally, and imaging features can be similar to malign neoplasms.[14]

Diagnosis is facilitated by Computed Tomography, and Magnetic Resonance Imaging. CT reveals a unilateral nasal mass that may be expansile. During the CT evaluation of a sinonasal mass increased density within the sinus may well be interpreted as part of the tumor when in reality it simply represents fluid in the blocked sinuses. Schwannomas can cause bone remodeling by pressure and this behavior can lead to misdiagnosis as a malignant process. Preservation of bony margins can be helpful in differentiating schwannomas from malignanttumors, which tend to aggressively destroy bone. However, in thecase of bony destruction and fragmentation,and intracranial or intraorbital extension, benign and malign processeslike esthesioneuroblastoma, fungal granuloma, nasoethmoidal carcinoma, and schwannoma cannot be differentiatedby CT examination.

MRI characteristics of schwannomas are typically isointense on T1-weighted images and hyperintense on T2-weighted sequences. MRI is useful to determine the intracranial extensionand better evaluate the cause of sinus obliteration (tumor versus inflammation) by contrast enhancement of thetumor.[9]

Differential Diagnosis

The differential diagnosis of schwannomas of the nasal and paranasal sinuses includes mucoceles, gliomas, papillomas, esthesioneneuroblastomas, sarcomas, carcinomas and lymphomas. The biopsies are frequently complicated by severe bleeding because of the extensive vascularization of most schwannomas, and the histologic diagnosis of schwannomas can be challenging. The pathologist must differrentiate schwannoma from neurofibroma, fibromatosis, fibrosarcoma, fibrous histiocytoma, fibrous dysplasia, ossifying fibroma, and osteosarcoma.[14-18]

MANAGEMENT

The treatment of choice in schwannomas is surgical excision of the tumor. Surgical resection is usually curative. Radiation therapy is usually reserved for malignant nerve sheath tumors. If tumor is confined to the paranasal sinuses, the prognosis is excellent. Functional endoscopic sinus surgery has the advantage of lower morbidity, no external incision, and a shorter hospital stay when compared with traditional approaches.[3, 19-21]

The surgical excision, depending on the site and extent of the lesion, various approaches can be utilised. These include mid-facial degloving, lateral rhinotomy or endoscopic approach. Mid-facial degloving and lateral rhinotomy are by far the most common operative procedures carried out for sinonasal diseases, particularly malignancy. Mid-facial

degloving provides good exposure of the middle third of the face. It utilises four basic incisions, bilateral sublabial incisions from maxillary tuberosity to tuberosity, bilateral intercartilaginous incision, septocolumellar complete transfixion incisions and bilateral pyriform aperture incisions extending to the vestibule. In lateral rhinotomy, incision is made along the nasal bridge from the medial canthusdown to the alar of the nose exposing the nasal cavity and the maxillary sinus. Though these procedures can offer wide surgical field exposure, they tend to leave surgical scars which may not be favourable to the patients. From one case reported of the nasal tip schwannoma the surgical technic incision is open rhinoplasty approach. From this access it provides to the tip framework. The better visibility that it offers makes the surgical maneuvers for the tumor resection easier and gives the surgeon the opportunity to diagnose the deformity in the cartilaginous or bony skeleton of the nose.[14,19,21]

Endoscopic sinus surgery was sufficient to remove most of the benign tumor because of its definite origin and benign nature. Endoscopic technique on the other hand can result in excellent outcomes if combined with other approaches. For example, endoscopic assisted maxillectomy can be offeredfor some nasal cavity tumours which extend to the maxillary sinus. This technique allows complete removal of a big tumour without leaving a surgical scar. Besides that, endoscopic approaches allows the tumour to be directly visualised on the monitor screen and the extent of tumour can be accurately assessed. In the paranasal sinus, there were reported cases with their localisations and the surgical approach and or treatment performed from 1974-2006. (Table 1)[14,19]

Report	Year	Localisation	Treatment/surgical approach
Calcatera et al	1974	Sphenoid	Frontotemporal approach + openingof the dura and intercapsular evacuation of the tumor; Maxillary sinus approach with subcapsular removal of the tumor
Miglets et al	1983	Frontal-ethmoid	Excised through a Lynch approach
Ross et al	1988	Maxillary sinus	Lateral rhinotomy, partial maxillectomy, removal of sphenoid + ethmoid sinuses
Chrisenbury et al	1984	Frontal-ethmoid	External approach combined with an endonasal approach and osteoplastic flap
Dublin et al.	1995	Ethmoid	Lateral rhinotomy
Srinvasan et al.	1999	Sphenoid	Endoscopic excision
Corina et al.	2000	Ethmoid	Paralateronasal rhinotomy
Sarioglu et al.	2002	Maxillary sinus	Excised by a large gingivo-buccal incision, sharp and blunt dissection

Cakmak et al.	2003	Frontal-anterior ethmoid	Combined endoscopic intranasal and external frontoethmoidectomy approach
Gillman and Bryson	2005	Ethmoid	Partial middle turbinectomy, total ethmoidectomy
Yu et al.	2006	Ethmoid	Excision of the lesion via transcranial approach

Table 1. Reported cases with their localisation and the surgical approach/treatment performed.

This tumor is categorised as a radioresistant tumor. Radiotherapy is used only in cases where there is an incomplete removal of the tumor or in cases where patients are not suitable for surgery because of underlying medical illness or in a case of a very extensive tumor.[14]

Prognosis

The recurrence is uncommon if the removal is complete and the tumor is confined to the nasal sinuses.[19]

Schwannomas are benign with only anecdotal cases of malignant transformation. Among the well over 1000 schwannomas that have been seen, there has been only one instance of true malignant transformation. In that case, the original tumor had the features of a classic schwannoma, whereas the recurrent tumor, 8 years later, had areas of malignancy. The patient later succumbed to metastatic disease.

Unlike neurofibromas, in which supervening malignancy resembles a spindle cell sarcoma, malignancy in schwannomas often has an epithelioid appearance. Areas of a conventional schwannoma are identified alongside confluent expanses of large, round, atypical eosinophilic cells. McMenamin and Fletcher reported several additional cases of malignant transformation. Noting microscopic collections of epithelioid cells in schwannomas, they represent the early stage of malignant transformation. They noted schwannomaswithmalignanttransformation toepithelioid angiosarcoma.[14,17,18]

Schwannomas show malignancy more often develop in association with von Recklinghausen's disease.[22,23]

Case Report

A 38-year-old woman was admitted to the ENT Oncology clinic of the Cipto Mangunkusumo Hospital with a 1-year history of progressive, unilateral left nasal obstruction, visual impairment involving the left eye, and exophtalmus.There were no lymphnode enlargement.

Nasal endoscopy showed narrow left nasal cavity, the lateral nasal wall pushed to the medial, the other structure can not be evaluated.

A computerised tomography (CT) scan of the paranasal sinuses showed a malignant mass involving the left maxillary sinus, left masticator space, left nasal cavity, left sphenoid sinus.There was bony erosion and destruction of the lateral and medial wall of the left maxillary sinus. The soft tissue mass also involving the left orbital cavity and forced the left inferior, lateral and medial recti oculi muscle and left optic nerve to the superior, and pushed the left oculi bulb to the anterior (proptosis). The other paranasal sinuses were clear. There was right perijugular lymphadenopathy.

Then biopsy was performed with sinuscopy procedure. Histologically, there were Antoni A and Antoni B appearance. The lession was composed of spindle-shape cell zones. Verocal body units were identified. Stroma was fibromyxoid. This histological examination confirmed the diagnosis of Schwannoma.

A surgical approach was planned and the tumor was radically removed by rinotomy lateral approach.Radical maxilectomy was performed with Moore incision and Lynch incision until infraorbital muscle and inferior orbita margin was exposed, the lateral, medial and posterior wall of the maxillary sinus was destructed, tumor was found in the left maxillary sinus, left nasalcavity and left retroorbita, left infratemporal fossa and left pterygomaxilla fossa. There was no mass in the sphenoid sinus. The bleeding was about 1700 cc.

Postoperative care in intensive care unit for 1 day and then she had wound care management in ward for five days.

Postoperative pathological examination reveales schwannoma.

The ophtalmology examination result were the left eye vision test: 1/300 and right eye vision test: 6/6, and diagnosed as ectropion, papil atrophy and lagophtalmus of the left eye.

The patient recovered with hyperesthesia of the left part of the face after surgery.

Patient underwent radiotherapy for 27 times.

Clinical Question

Is radiotherapy effective for treatment the uncomplete surgical removal of Schwannoma Sinonasal with infratemporal fossa involvment?

Literature Search

Literature search was done using PUBMED, Clinical Key and Highwire with the keyword schwannoma OR neurilemma AND sinonasal OR paranasal sinuses and we obtained 328 literatures. Literature search was continued by filtering journal and screening title abstract and we obtained 25 literatures.

From all the 25 literatures we did not find any literature with the highest evidence which is the Randomized Controlled Trial or metaanalysis. Critical appraisal was made based on validity, importance and applicability of the study.

Analysis

Analysis on the journals gave a low validity because none of the studies were randomized nor underwent blinding process. In case of surgery, blinding and randomizationis

difficult because each case are individual in nature of the disease but all cases in the jornals were treated with surgical resection. Reading all literature only one literature were treated with radiation therapy except the malignant cases.

DISCUSSION

Schwannoma is a benign tumor arising from the sheath of myelinated nerve fibers and may occur in any part of the body. Neural tumor are very unsual in the sinonasal tract. The precise origin of sinonasal schwannoma is uncertain, as there many nerves in the region that involved. The most common symptoms of sinonasal Schwannomas are unilateral nasal obstruction, epistaxis, hyposmia and pain. Exophtalmus, facial swelling, epiphora and progressive visus reduction are less frequently described. This patient came to us after she got a progressive unilateral nasal obstruction for 1 year and she never had any medication before.

The greatest incidence between second and fourth decades.

Although specific diagnosis from imaging study is difficult, CT Scan is helpful in defining the origin and location of the tumor and the involvement of vital structures around lession. High resolution CT Scanning is considered to be an adequate imaging investigation for schwannomas of paranasal sinus. As exemplified in this case, imaging may not be sufficient to allow a definitive diagnosis of a schwannoma in the paranasal location. CT Scan usually show a contrast-enhancing tumor of varying signal intensity. Postcontrast, the tumors show mottled central hypodens foci with peripheralenhancement. The heterogeneous appearance is related to areas of increased vascularity with adjacent nonenhancing cystic or necrotic regions, which is an important feature in distinguishing it from inflammatory polyps. Also there is bone involvement and erosion of bone structure.

Magnetic resonance imaging (MRI) with gadolinium contrast is indicated area with intraorbital or intracranial extension and for more exact delineation of the tumor from the normal soft tissue. MRI images may supply more useful information as lesions may appear typically isointense MRI is helpful in differentiating the neoplasm from retained secretion or inflammatory changes. This patient had no MRI examination.

Due to these nonspecific imaging feature of schwannoma, the clinical and radiological differential diagnosis for sinonasal mass must include polyps, mucocele, angiofibroma, inverted papilloma, melanoma, squamous carcinoma, adenocarcinoma, sarcoma, meningioma, lymphoma and schwannoma This case is a reminder to include schwannoma in the clinical differential diagnosis in patients who present with sinonasal mass.

Histologically, schwannoma present in a biphasic histological pattern Antoni A and Antoni B areas. This agrees with the result of histologic examination from biopsy mass.

The definitive treatment of schwannoma in the paranasal sinuses is complete surgical excision. The surgical approach depends on the location and the extent of the tumor. In some cases, complete excision can be done endoscopically. In others, surgery may involve various combination of approaches. An external approach, including lateral rhinotomy, degloving, and medial maxillectomy might be more feasible for extensive or malignant lesions. The treatment of this caseis surgical excision with surgical approach by lateral rhinotomy with Moore incision and Lynch incision due to mass involving the left maxillary sinus, left masticator space, left nasal cavity, left sphenoidalis sinus, bony erosion and destruction of the lateral and medial wall of the left maxillary sinus.

Early total surgical excision might have prevented its recurrence with widespread and intracranial infiltration and possibly its late malignant formation.Radiotherapy is used because of there is an incomplete removal, this patient underwent radiotherapy for 27 times and observed until 6 month postradiation.

The conventional radiation therapy is not indicated for patients after a complete or near total resection. It should be considered in patient with substantial residual tumor after surgery, for recurrent tumors in advanced stages of the disease, and for those patients with large tumors who are poor surgical candidates. The irradiation significantly reduced the possibility of tumor progression.

The consideration of radiation therapy for this patient were the involvement of infratemporal fosa that can not completed surgically managed, and the characteristic of this tumor that cause bony erotion and destruction of inferior, lateral and medial maxillary sinus wall.

In patient with sinonasal malignancies, the proximity of the orbit to the tumor places it at risk for invasion or treatment related damaged. The eye can often be preserved without compromising overall survival or local control. The recognized indications for orbital exenteration have evolved. More recent commonly accepted indications have included penetration through the periorbita into orbital fat and invasion of extraocular muscles, the optic nerve, or orbital apex. Proptosis or diplopia may be due tu displacement of orbital contents, decreased visual acuity or the presence of an afferent pupillary defect usually indicates gross orbital invasion.

This patient didn’t get orbita exenteration because schwannoma is benign tumor. Resection of the orbital floor or periorbital dissection may lead to postoperative problems, including enophtalmos, ectropion, canthal dystopia, epiphora, and diplopia. Because of this postoperative problem in young adultwoman patient, this orbita exenteration was not considered.

Flowchart

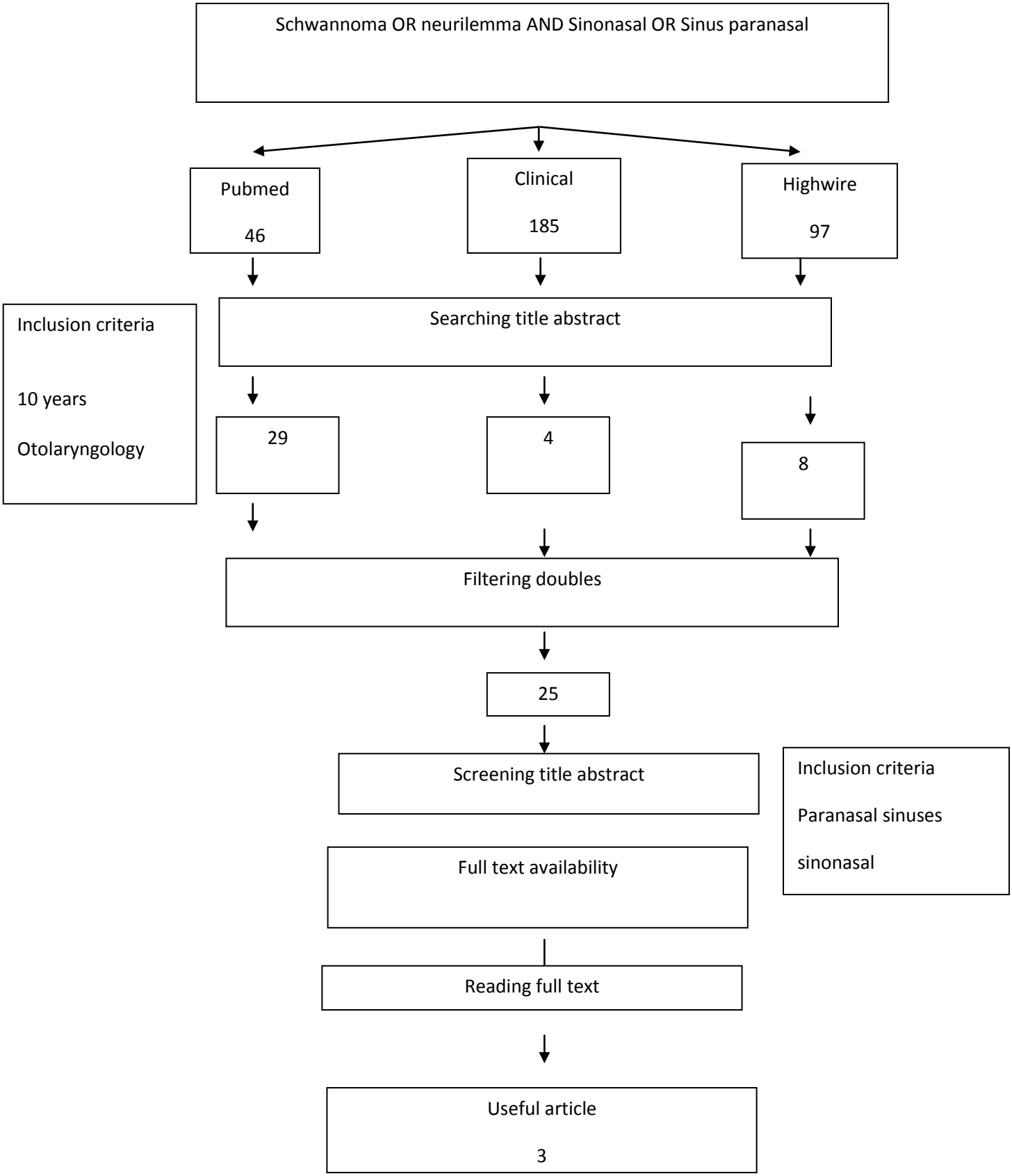

Schwannoma OR neurilemma AND Sinonasal OR Sinus paranasal
Pubmed
46
Clinical
185
Highwire
97
Inclusion criteria
10 years
Otolaryngology
Searching title abstract
29
4
8
Filtering doubles
25
Screening title abstract
Inclusion criteria
Paranasal sinuses
sinonasal
Full text availability
Reading full text
Useful article
3

Table 2. Literature search

Engine	Search Terms	Results
Pubmed	((("neurilemmoma"[MeSH Terms] OR "neurilemmoma"[All Fields] OR "schwannoma"[All Fields]) OR ("neurilemma"[MeSH Terms] OR "neurilemma"[All Fields])) AND ("paranasal sinuses"[MeSH Terms] OR ("paranasal"[All Fields] AND "sinuses"[All Fields]) OR "paranasal sinuses"[All Fields] OR ("sinus"[All Fields] AND "paranasal"[All Fields]) OR "sinus paranasal"[All Fields])) OR Sinonasal[All Fields]	46
Clinical Key	Schwannoma OR Neurilemma ANDSinonasal OR Sinus paranasal	185
Highwire	Schwannoma OR Neurilemma ANDSinonasal OR Sinus paranasal	97

Table 3. Title and literature review

No	Title	Researcher	Journal
1	Atypical sinonasal schwannoma: a difficult diagnostic challenge.	Galli J. Imperiali M. Cantore I. et al.	Auris Nasus Larynx. 2009; 36; 482-486.
2	Frontal Sinus Schwannoma.	Mangubat, EZ. Pitelka L, et al.	Skull Base Report. 2011; 1 (1): 17-21.
3	Nasosinusal schwannoma.	Paradinaz MR. Rivera T.	Acta Otorrinolaringol Esp. 2010; 61(4); 321-323

REFERENCE

1. Benign Tumors of the Sinonasal tract. In:Flint PW, Haughey B, Lund VJ, Niparko JK, Richardson MA, Robbins KT, *et al*. editors. Cumming Otolaryngology Head and Neck Surgery. 5th Ed.Philadelphia (PA):Mosby Elsevier; 2010.
2. Kim DH, Friedman AH, Kitagawa RS, Kline DG. Benign Tumors of the Peripheral Nerve. In: Winn HR, editor.Youmann Neurological Surgery. 6th Ed.Philadelphia (PA):Elsevier Saunders; 2011.
3. Ulu EM, Cakmak Ö, Donmez FY, Buyuklu F, Cevik B, Akdogan V, et al. Sinonasal schwannoma of the

middle turbinate. Diagnostic and Interventional Radiology. 2010; 16(2): 129-31.
4. Skouras A, Skouras G, Diab A, Asimakopulou FA, Dimitriadi K, Divritsioti M. Schwannoma of the nasal tip: Diagnosis and Treatment. Aesthetic Plastic Surgery. 2011; 35: 657-61.
5. Somasekhar, Lakshmi S, Ramya S. Sinonasal schwannoma with secondary changes. Otolaryngology Head Neck Surgery. 2008; 60: 274-6.
6. Mey KH, Buchwald C, Daugaard S, Prause JU.Sinonasal Schwannoma: a clinicopathological analysis of five rare case. Rhinology. 2006; 44: 46-52.
7. Yang TL, Hsu MC, Liu CM. Nasal schwannoma: a case report and clinicopathologic analysis. Rhinology. 1999; 39: 169-72.
8. Ohashi R. Wakayama N, Kawamoto M, Tsuchiya S, Okubo K. Solitary Nasal Schwannoma. J Nippon Med Sch. 2013; 80 (4): 300-5.
9. Yu E, Mikulis D, Nag S. CT and MR Imaging findings in sinonasal schwannoma. Am J Neuroradiology. 2006; 27: 929-30.
10. Mangubat EZ, Pitelka L, Petruzzelli GJ, Byrne RW. Frontal Sinus Schwannoma. Skull Base Report. 2011; 1 (1): 17-21.
11. Park EH, Lee SS, Byun SW. A schwannoma in the nasal septum. Eur Arch Otorhinolaryngol. 2008; 265: 983-5.
12. Paradinaz MR. Rivera T. Nasosinusal schwannoma. Acta Otorrinolaringol Esp. 2010; 61(4); 321-3.
13. Kodama S, Okamoto T, Suzuki M. Ancient schwannoma of the nasal septum associated with sphenoid sinus mucocele. Auris Nasus Larynx. 2010; 37: 522-5.
14. Galli J, Imperiali M, Cantore I, Corina L, Larocca LM, Paludetti G. Atypical sinonasal schwannoma : a difficult diagnostic challenge. Auris Nasus Larynx. 2009; 36: 482-6.
15. Buob D, Wacrenier A, Chevalier D, Aubert S, Quinchon JF, Gosselin B, et al. Schwannoma of the sinonasal tract. Arch Pathol Lab Med. 2003; 127: 1196-9.
16. Wang LF, Tai CF, Kuen YH, Ruo WR. Schwannoma of the nasal septum: a case report. Kaohsiung J Med Sci. 2004; 20: 142-5.
17. Janardhanan S, Kulothungan, Felix V. Schwannoma of the nasal septum: a case report. Otolaryngology online journal. 2012; 2 (3).
18. El-Saggan A, Olofsson J, Krossnes B. Sinonasal schwannoma : two case reports and review of literature. International Congress Series. 2003; 1240: 503-7.
19. Lazim NM, Mohamad I, Ramli RR, Khan SA, Win TT, Yunus S. Endoscopic removal of an extensive sinonasal schwannoma. Brunei Int Med Journal. 2010; 6(3): 135-9.
20. Quesada JL, Enrique A, Lorente J, Lopez D, Quesada P. Sinonasal schwannoma treated with endonasal microsurgery. Otolaryngology- Head and Neck Surgery. 2003; 129(3): 300-2.
21. Ramalingam KK, Ramalingam R, Murthy S, Nadig V. Role of endoscope and microdebrider in the excision of skull base schwannoma arising from the sphenoid sinus. Indian Journal of Otolaryngology Head and Neck Surgery. 2004; 56(3): 242-4.
22. Jana U,Saha AK. Malignant melanotic schwannoma of maxilla. Indian Journal of Otolaryngology and Head and Neck surgery. 2002; 54(4): 303-4.
23. Maheshwari GK, Baboo HA, Gopal U et al. Malignant Schwannoma of the sinonasal tract. Indian Journal of Otolaryngology and Head and Neck surgery. 1999; 51(1): 47-50.