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Skull Base Chondrosarcomas: Surgical Treatment and Results

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Objectives: We describe our experience in the management of patients with skull base chondrosarcoma, an uncommon neoplasm of the skull base.

Methods: Thirteen cases of surgically treated skull base chondrosarcomas were identified. The patients' follow-ups ranged from 7 to 86 months (mean, 47 months).

Results: The most common tumor locations were the jugular foramen (5 cases), the petrous apex (3 cases), and the petroclival region (3 cases). An infratemporal fossa type A approach was performed in 2 cases, and 2 patients underwent an infratemporal fossa type B approach. Two patients underwent a transotic approach, 1 patient underwent a petro-occipital transsigmoid approach, and a petro-occipital transsigmoid approach combined with a transotic approach was chosen in 1 case. One patient underwent an infratemporal fossa type C approach combined with a transotic approach, and 2 patients underwent an infratemporal fossa type B approach combined with a transotic approach. One patient underwent an infratemporal fossa type B approach combined with a transzygomatic approach, and the last patient underwent a transmastoid approach. Gross total tumor removal was achieved in all patients. Postoperative radiotherapy was performed in 7 cases. The most common complications were lower cranial nerve deficits. Two patients experienced recurrences, 36 months and 6 years after surgical removal.

Conclusions: We believe that the primary treatment for chondrosarcomas of the skull base is gross total surgical resection. We usually do not recommend radiotherapy as the primary treatment for patients with skull base chondrosarcomas; however, radiotherapy may be considered as an alternative primary treatment in selected cases in which there are serious medical contraindications to surgery, as well as in elderly patients. We reserve postoperative radiotherapy for patients with histologically aggressive tumors (grade II or III), as well as for cases of subtotal resection or recurrent tumors.

Key Words: chondrosarcoma, clivus, petrous apex, skull base tumor, surgery, temporal bone.

INTRODUCTION

Chondrosarcomas of the skull are rare, slow-growing, locally aggressive tumors that constitute 0.15% of all intracranial neoplasms.[1] Approximately three fourths of all chondrosarcomas of the skull occur at the cranial base, accounting for 6% of all neoplasms at this site.[1-3] Chondrosarcoma affects both sexes equally, and the mean age of tumor presentation is the fourth or fifth decade of life.[4-6] It has been hypothesized that cranial base chondrosarcomas may originate from multipotential mesenchymal cells[4,7] or from embryonal cartilage remnants of skull synchondroses.[2,5,7-9] The most common tumor sites of origin have been reported to be the petroclival, petro-occipital, spheno-occipital, and sphenopetrosal synchondroses.[5] Histopathologically, chondrosarcomas are divided into the following subtypes: conventional (myxoid and hyaline types), dedifferentiated, clear cell, and mesenchymal; the conventional form is the most common type within the skull base.[10,11] The dedifferentiated and mesenchymal variants are more aggressive and may metastasize, but account for less than 10% of all skull base chondrosarcomas.[10,12] Conventional chondrosarcomas are further subdivided into three grades based on cellularity, the nuclear size of the cells, the chondroid matrix, and nuclear atypia: well differentiated (grade I), moderately differentiated (grade II), and poorly differentiated (grade III). The variable location of these tumors, their large size at diagnosis, their frequent encroachment on neurovascular structures, and their tendency to invade surrounding bones are some of the criteria that make resection difficult. Surgery is considered the standard of care in the treatment of skull base chondrosarcomas. Proton beam radiotherapy, radiosurgery (gamma knife or Cyber knife), or stereotactic radiotherapy is often used as adjuvant treatment.[11-14] In the present study we reviewed the management and outcomes of 13 patients with a diagnosis of skull base chondrosarcoma treated at a single center.

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TABLE 1. PATIENT DEMOGRAPHICS, LOCATION OF TUMOR, TYPE OF OPERATION, AND POSTOPERATIVE COMPLICATIONS

Pt No.	*Sex*	*Age (y)*	*Preop LCN Deficits*	*Site of Tumor*	*Surgical Approach*	*Gross Total Removal*	*Postop Radiotherapy*	*New LCN Deficits*	*Preop/ Postop Hearing*	*Histologic Grade*	*Site and Time of Relapse*	*Follow-Up (mo)*
1	F	54	IX-X	JF, EAC, ME, IAC, PCF, CC	TO + angular vein ligature	Yes	No	None	DE/DE	I	No	63
2	M	60	None	JF, ME, CC, cochlea	IFTA	Yes	No	IX, X	NH/DE	I	No	68
3	M	34	X	JF, ME, IR, neck	IFTA	Yes	No	IX, XI	NH/CHL	I	No	42
4	F	56	IX, X	JF, IR, PCF	POTS	Yes	Yes	XI	NH/NH	II	No	32
5	F	35	IX-XII	JF, PA, CC	POTS + TO	Yes	Yes	None	NH/DE	I	No	55
6	M	44	None	PA, clivus, CC, JF, PCF	IFTB + TO (1st stage); POTS (2nd stage)	Yes	No	None	NH/DE	I	PA (6 y)	86
7	M	40	None	PA, clivus, CC, OC, PCF	IFTB + TO (1st stage); far lateral (2nd stage)	Yes	Yes	XII	NH/DE	I	No	26
8	M	53	None	IR	Transmastoid	Yes	No	None	NH/NH	I	No	50
9	F	39	None	IF, CC, cochlea	IFTB + transzygomatic	Yes	Yes	None	NH/DE	III	No	74
10	F	31	None	PA, clivus, JF, CC, ME, PCF, IF, nasopharynx, sphenoid	IFTC + TO (preop ICA balloon occlusion)	Yes	Yes	IX, X	CHL/DE	II	JF (36 mo)	37
11	F	38	None	PA, CC, CS	IFTB (preop ICA stent)	Yes	No	None	NH/CHL	I	No	36
12	F	59	None	PA, OC, ME, cochlea	TO	Yes	Yes	None	MHL/DE	II	No	7
13	F	44	None	PA	IFTB	Yes	Yes	None	NH/CHL	II	No	37

LCN — lower cranial nerve; JF — jugular foramen; EAC — external auditory canal; ME — middle ear; IAC — internal auditory canal; PCF — posterior cranial fossa; CC — carotid canal; TO — transotic approach; DE — dead ear; IFTA — infratemporal fossa type A; NH — normal hearing; IR — infralabyrinthine region; CHL — conductive hearing loss; POTS — petro-occipital transsigmoid; PA — petrous apex; IFTB — infratemporal fossa type B; OC — occipital condyle; IF — infratemporal fossa; IFTC — infratemporal fossa type C; ICA — internal carotid artery; CS — cavernous sinus; MHL — mixed hearing loss.

MATERIALS AND METHODS

We conducted a retrospective review of patients with chondrosarcoma of the skull base registered at Gruppo Otologico Piacenza-Rome between 1990 and 2012. Thirteen patients with chondrosarcoma of the skull base were identified by means of a computerized search and became the subjects of the study. The collected data were analyzed for age, sex, presenting signs and symptoms, operative procedures, location and extent of the tumor, histologic features, and postoperative outcomes. All patients underwent complete otologic and neurologic examinations, flexible fiberoptic laryngoscopy, and hearing assessment. All patients were evaluated before surgery with high-resolution computed tomographic (CT) scans with bone windows and gadolinium-enhanced magnetic resonance imaging (MRI). Arteriovenous magnetic resonance angiography was performed in 5 patients, and four-vessel angiography was performed in 8 patients. The facial nerve (FN) function was evaluated before the operation and 1 year after the operation with the House-Brackmann (HB) system.[15]

RESULTS

General Characteristics and Clinical Manifestations. The study group was composed of 13 patients with histologically confirmed skull base chondrosarcomas. Table 1 shows the demographic characteristics, tumor locations, treatments, and outcomes of the investigated group. Eight patients (53.8%) were female, and 5 (38.5%) were male. The mean age at the time of surgery was 45.1 ± 10 years (range, 31 to 60 years). The durations of follow-up (consisting of clinical evaluation, hearing tests, flexible fiberoptic laryngoscopy, and serial CT and MRI scans) ranged from 7 to 86 months (mean, 47 ± 21.6 months). Eleven tumors (84.6%) were on the right side, and 2 (15.4%) were on the left side. The presenting symptoms and signs are listed in Table 2. Diplopia due to abducens nerve palsy (46.1%), hearing loss (38.4%), tinnitus (30.7%), and dysphonia (30.7%) were the most common presenting complaints. The mean duration of symptoms before presentation was 15 ± 13.6 months (range, 2 to 45 months). Four patients (30.7%) were found to have at least one lower cranial nerve (CN) deficit at presentation.

TABLE 2. PRESENTING FEATURES IN 13 PATIENTS

Symptom or Sign	*No.*	*%*
Diplopia	6	46.1
Hearing loss	5	38.4
Tinnitus	4	30.7
Dysphonia	4	30.7
Dysphagia	3	23.1
Unsteadiness	3	23.1
Vertigo	3	23.1
Retrotympanic gray mass	2	15.4
Facial nerve palsy	2	15.4
Facial paresthesia	1	7.7
Headache	1	7.7
Shoulder weakness	1	7.7
External auditory canal polypoid mass	1	7.7

TABLE 3. TUMOR LOCATIONS IN 13 PATIENTS

Location	*No.*	*%*
Carotid canal	8	61.5
Petrous apex	7	53.8
Jugular foramen	7	53.8
Middle ear	5	38.5
Posterior cranial fossa	5	38.5
Cochlea	3	23.1
Clivus	3	23.1
Infralabyrinthine region	3	23.1
Infratemporal fossa	2	15.4
Occipital condyle	2	15.4
Cavernous sinus	1	7.7
Nasopharynx	1	7.7
Sphenoid sinus	1	7.7
Neck	1	7.7
Internal auditory canal	1	7.7
External auditory canal	1	7.7

Location of Tumor. The location and the extent of the lesions were determined before surgery from the radiology reports, and were confirmed during the operation. Five patients had lesions that were centered on the jugular foramen, 3 patients had lesions that arose from the petrous apex, 3 patients had lesions of the petroclival region, 1 patient had a lesion involving the infratemporal fossa, and 1 patient had a small lesion in the infralabyrinthine region. The frequencies of involvement of the various structures are presented in Table 3. Patients with jugular foramen involvement had the jugular bulb compressed and already closed off by the tumor. None of the patients had an ipsilateral dominant sinus or insufficient collateral venous drainage, and none underwent preoperative embolization.

Treatment, Tumor Resection, and Pathological Findings. All patients were treated surgically. Twelve patients had undergone no previous therapy, and 1 patient (No. 3) presented with a recurrent tumor previously operated on elsewhere by the suboccipital approach. Eleven patients underwent single-stage tumor removal, and 2 patients required a second-stage operation to achieve total tumor removal. No patients had undergone preoperative radiotherapy. A transotic approach extending to the neck with ligature of the internal jugular vein was performed in 1 patient (No. 1), who presented with a dead ear and a tumor arising from the jugular foramen with involvement of the cerebellopontine angle, middle ear, and external auditory canal, together with erosion of the carotid canal. During surgery, the tumor was found to invade the mastoid portion of the FN and was intentionally transected and reanastomosed with a sural nerve graft. A transotic approach was also used in another patient (No. 12) with a tumor involving the petrous apex, occipital condyle, middle ear, and cochlea. One patient (No. 2) with good preoperative hearing and a tumor limited to the jugular foramen and spreading into the hypotympanum and the vertical internal carotid artery (ICA) underwent an infratemporal fossa type A[16] (IFTA) approach; the FN was sacrificed and sural nerve grafting was performed because of infiltration of the mastoid portion of the facial nerve. Patient 3 underwent an IFTA approach with permanent anterior transposition of the FN on account of tumor extension into the infralabyrinthine region, middle ear, and upper neck. Patient 4, who had good preoperative hearing and tumor involving the jugular foramen and the infralabyrinthine region and extending into the posterior cranial fossa, without middle and inner ear involvement, underwent tumor removal through the petrooccipital transsigmoid (POTS) approach. Patient 5, who had a tumor involving the jugular foramen and the petrous apex, together with a tumor component located anteromedial to the vertical ICA, required a combined POTS-transotic approach. Patient 10 underwent an infratemporal fossa type C[16] (IFTC) approach combined with the transotic approach for a petroclival tumor extending into the infratemporal fossa, sphenoid sinus, and nasopharynx. This patient underwent preoperative permanent balloon occlusion of the ICA on account of circumferential petrous carotid encasement. In 2 cases (patients 6 and 7), subtotal removal with an infratemporal fossa type B[16] (IFTB) approach combined with the transotic approach was planned to resect a petroclival tumor that had carotid canal involvement and extended into the posterior cranial fossa. In 1 of these 2 cases, a residual tumor was left in place at the occipital condyle and removed via a far-lateral approach 3 months after the first surgery; in the remaining case, a POTS approach was used to remove a resid-

TABLE 4. HOUSE-BRACKMANN SCORES

Pt No.	*Preoperative*	*Immediate Postoperative*	*Follow-Up*
1	II	VI*	III
2	VI	VI*	II
3	I	IV†	I
4	I	I	I
5	I	VI	III
6	I	VI	I
7	I	III	I
8	I	I	I
9	I	I	I
10	I	I	I
11	I	I	I
12	I	I	I
13	I	I	I

*Sural nerve grafting.
†Anterior rerouting.

ual tumor at the jugular foramen 10 months after the first stage. Two patients (Nos. 11 and 13) underwent an IFTB approach for tumors involving the petrous apex; 1 of these 2 patients (No. 11) required preoperative stenting of the ICA on account of cavernous sinus involvement. Patient 9 underwent an IFTB approach combined with the transzygomatic approach for a huge tumor involving the infratemporal fossa and eroding the cochlea and the carotid canal. Finally, a transmastoid approach was used for a small tumor limited to the infralabyrinthine region (patient 8). Gross total tumor removal was achieved for all patients. Two patients with grade I tumors and all patients with grade II or grade III tumors underwent postoperative radiation therapy.

Facial Nerve Outcomes. Table 4 summarizes the FN results. Eleven patients (84.6%) had grade I preoperative FN function. Preoperative FN dysfunction was present in 2 patients (Nos. 1 and 2), both of whom had high-resolution CT evidence of fallopian canal involvement by the tumor. In these 2 patients, the mastoid segment of the FN was resected because of tumor infiltration, and the defect was repaired with a sural nerve graft in the same sitting. Both of these patients had HB grade VI function immediately after surgery; at 1-year follow-up, 1 patient reached grade III, and the other recovered to grade II. One patient (No. 3) who underwent an IFTA approach and permanent anterior transposition of the FN had grade VI palsy in the immediate postoperative period, but reached grade I after a year. The patient (No. 5) who underwent a POTS-transotic approach had grade VI function immediately after surgery and recovered to grade III after a year. Of the 2 patients (Nos. 6 and 7) who underwent an IFTB-transotic approach, 1 had grade VI function immediately after surgery and 1 had grade III; both had recovered to grade I at the 1-year follow-up.

Hearing Outcomes. Hearing preservation surgery was attempted in 7 patients. The 2 patients treated with an IFTA approach had preoperative audiometric testing within normal limits. In 1 of these 2 patients (No. 2), the cochlea was found to be eroded by the tumor and was drilled to achieve total tumor removal. The other patient had postoperative conductive hearing loss. Hearing was preserved at the preoperative level (normal hearing) in the patient (No. 4) in whom hearing preservation was attempted via the POTS approach. Three patients (Nos. 9, 11, 13) treated with an IFTB approach had good preoperative hearing. Two of these patients had postoperative conductive hearing loss, and 1 had postoperative deafness resulting from the necessity of drilling the cochlea because of erosion by the tumor. Tumor removal without hearing preservation was performed in 6 cases. One of these 6 patients (No. 1) was already deaf before surgery. In the remaining 5 patients (Nos. 5, 6, 7, 10, 12), the inner ear was sacrificed in order to accomplish safe and total tumor removal.

Complications, Lower Cranial Nerve Status, and Long-Term Follow-Up. There were no perioperative or postoperative deaths, nor cases of cerebrospinal fluid leakage, meningitis, or vascular injury, in the present series. The function of the lower CNs paralyzed before surgery did not recover after surgery in any of the patients. A new deficit of one or more of the lower CNs was recorded in 5 patients (41.6%). Two patients had a new paralysis of CNs IX and X and required a prophylactic nasogastric feeding tube in the immediate postoperative period. One patient had paralysis of CNs IX and XI. Cranial nerve XI alone was lost in 1 case. A new isolated deficit of CN XII occurred in 1 case. On long-term follow-up, all patients were able to compensate well for their lower CN deficits with the help of speech and swallowing rehabilitation. Physical therapy was administered in the patient with CN XI paralysis to prevent persistent shoulder dysfunction and pain. One patient had permanent CN VI paralysis (No. 13). Two patients (15.3%) had recurrences, 36 months and 6 years after surgical removal, and were treated with radiotherapy. Serial follow-up MRI demonstrated that these 2 patients had no evidence of growth at 12 and 37 months from the diagnoses of recurrence. So far, no patient has developed a distant metastasis (average follow-up, 47 months; range, 7 to 86 months).

DISCUSSION

Skull base chondrosarcomas are rare lesions, and

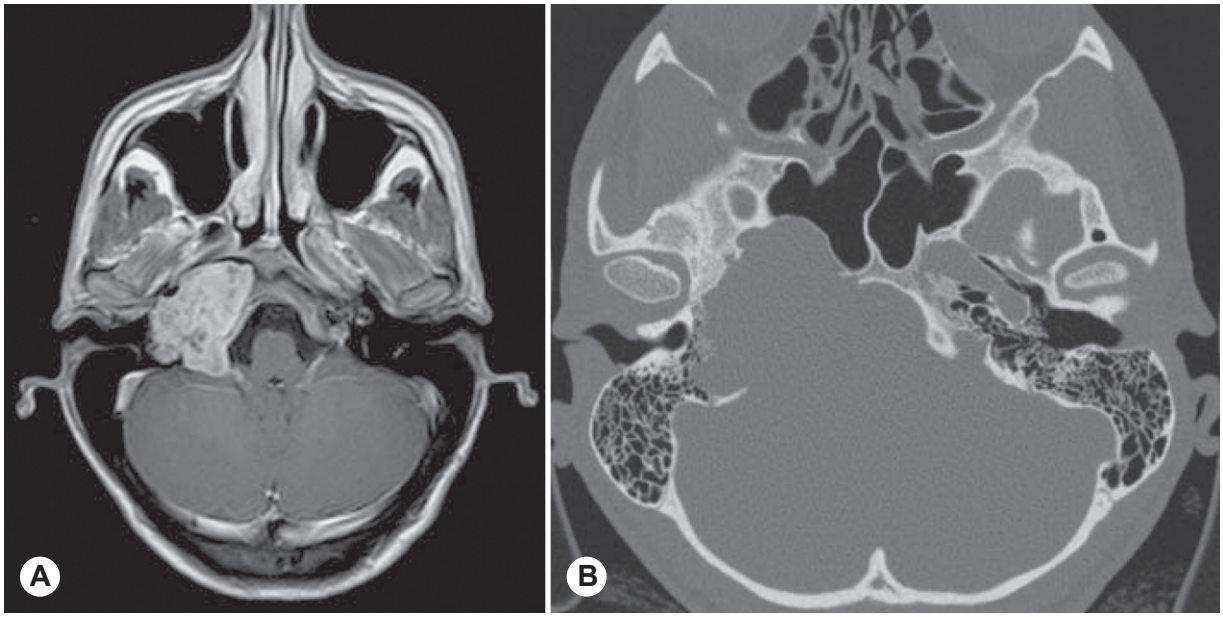

Fig 1. (Patient 10) **A)** Axial T1-weighted magnetic resonance image with gadolinium enhancement shows right petroclival chondrosarcoma. Tumor shows heterogeneous enhancement and appears to be confined to extradural space even though posterior cranial fossa dura is pushed medially. Internal carotid artery is encased by tumor and anteriorly displaced. **B)** Axial high-resolution computed tomographic scan with bone windows of same tumor shows irregular bone erosion of petrous apex and clivus.

only a few single-institution series have been reported that included more than 10 patients.[4,6,10,11,17-19] Because of the small numbers of patients in each of the series reported and the treatment heterogeneity, there is still no definitive recommendation for the management of these tumors. Total surgical resection, different radiation techniques, and the combination of surgery and postoperative irradiation have all been proposed for the treatment of chondrosarcomas of the skull base.[2,4-7,11-14] Skull base chondrosarcomas represent a surgical challenge, and controversy continues on the choice of surgical approach. The primary goal of surgical treatment should be to achieve total tumor removal with minimal surgical morbidity.[6,11,19,20] Different surgical approaches, both anteriorly and laterally based, have been described for resection of skull base chondrosarcomas, including the retrosigmoid,[6] IFTA,[16] transtemporal-infratemporal,[21] combined infratemporal and posterior fossa,[22] transpetrosal-subtemporal craniotomy,[23] subtemporal-transpetrous,[24] petro-occipital transsigmoid,[25,26] extended frontal,[27] supra-infratentorial pre–sigmoid sinus,[28] and transsphenoid[29] approaches.

In the present series, we mainly used the infratemporal approach with its variants (A, B, and C). Infratemporal approaches are versatile procedures that can be combined, if necessary, with other approaches (eg, translabyrinthine, transotic, transcochlear, transzygomatic).[5,9,16,30,31] The IFTA approach provides excellent control of the petrous apex, jugular foramen, and infralabyrinthine areas, as well as the vertical portion of the ICA.[16] The IFTA approach has the disadvantages of a postoperative conductive hearing loss resulting from ear canal closure and FN paresis related to the anterior rerouting of the FN. We used the IFTA approach in 2 cases of chondrosarcoma centered on the jugular foramen with involvement of the vertical segment of the ICA. If the tympanic cavity and FN are not involved, we prefer the POTS approach[25,26] over the IFTA approach. A posterolateral (POTS) approach to the skull base offers a direct, conservative route to the jugular foramen and adjacent areas while keeping the FN in place and preserving the external auditory canal and middle ear. Areas that can be checked by this approach include the jugular foramen, cerebellopontine angle, occipital condyle, ipsilateral lower clivus, vertical portion of the ICA, and jugulocarotid space.

In this series, we used the POTS approach in a case of chondrosarcoma centered on the jugular foramen with extension into the posterior cranial fossa. In another case, the POTS approach was combined with a transotic approach because of a massive erosion of the carotid canal. The IFTB approach is designed mainly for lesions involving the petrous apex and midclivus. This approach allows adequate control of the vertical and horizontal intrapetrous ICA while preserving the FN and the inner ear. The IFTB approach has the disadvantages of postoperative conductive hearing loss due to ear canal closure and the need to sacrifice the mandibular nerve.

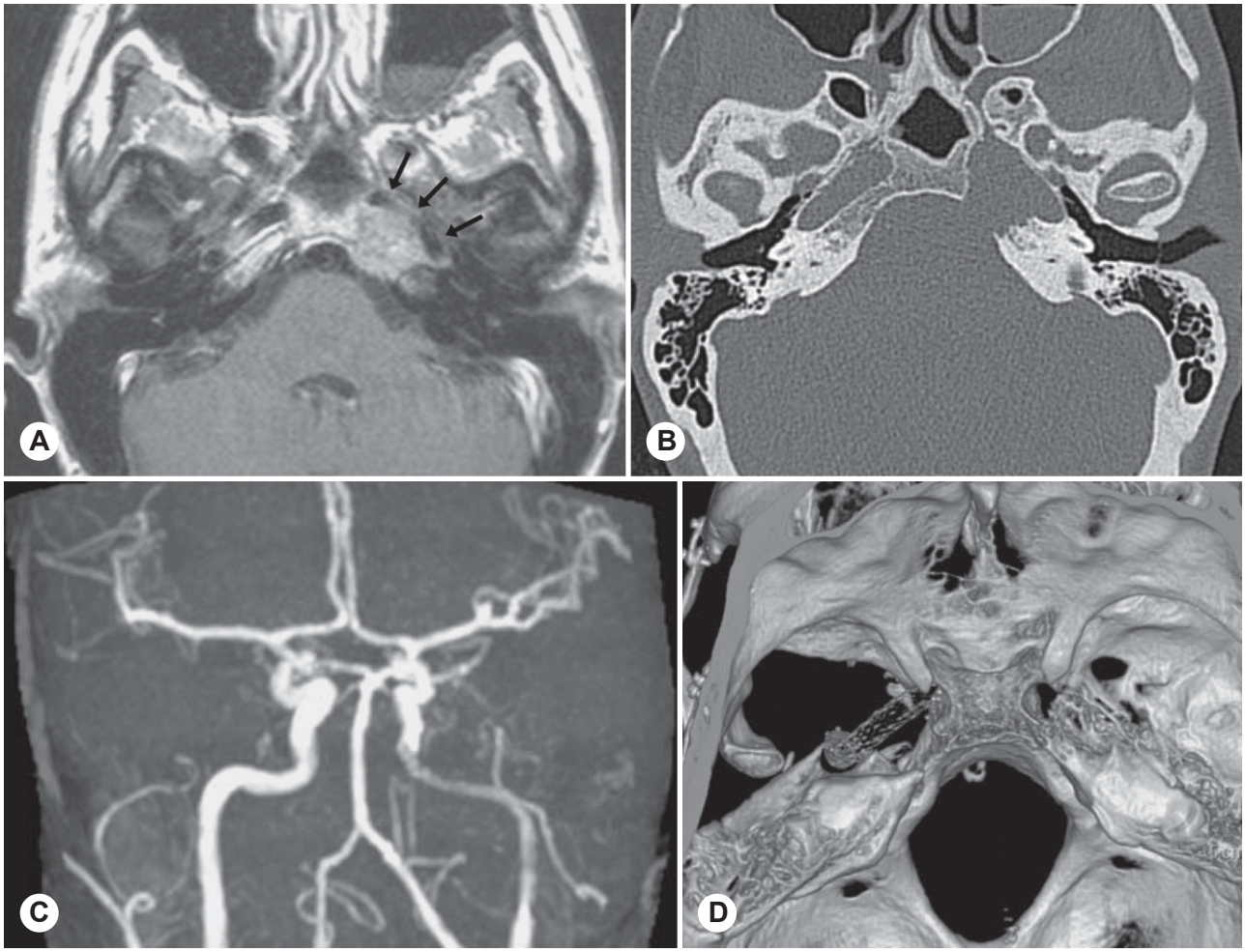

Fig 2. (Patient 11) **A)** Axial T1-weighted magnetic resonance image with gadolinium enhancement shows left chondrosarcoma involving petrous apex. Internal carotid artery lumen (arrows) is narrowed. **B)** Axial high-resolution computed tomographic scan of same lesion shows erosion of horizontal portion of carotid canal. **C)** Magnetic resonance angiogram with maximum-intensity projections demonstrates narrowing of cervical and petrous portions of internal carotid canal. **D)** Three-dimensional shaded surface display reconstruction from computed tomographic scan shows surgical defect that resulted from infratemporal type B approach. Note mesh of stent inside internal carotid artery.

Because the cochlea is preserved, tumors lying between the medial aspect of the cochlea and the internal auditory canal are not well controlled. In these cases, the IFTB approach may be combined with a transotic approach. In this series, 5 patients underwent an IFTB approach, which was combined with a transotic approach in 2 of them. The IFTC is an anterior extension of the type B approach in which the pterygoid process is drilled, providing control of the nasopharynx, pterygopalatine fossa, and sphenoid sinus. It gives lateral access for extirpation of extradural lesions involving the infratemporal fossa, the pterygopalatine fossa, the sphenoid sinus, and the intrapetrous ICA up to the precavernous segment.

We used an IFTC approach combined with a transotic approach for a huge petroclival chondrosarcoma with a tumor component in the nasopharynx and sphenoid sinus. Two patients in this series required preoperative interventional neuroradiologic management of the ICA. The first patient had a huge petroclival chondrosarcoma; imaging studies showed encasement of the intratemporal tract of the ICA together with angiographic signs of stenosis (Fig 1). Adequate collateral flow through the circle of Willis permitted permanent occlusion of the ICA by the balloon technique. The patient underwent total tumor removal by an IFTB approach combined with a transotic approach, without complications. The second patient underwent stenting of the petrous and cervical segments of the ICA because of a tumor involving the petrous apex with extension into the cavernous sinus (Fig 2). The collateral flow through the circle of Willis was not adequate to permit permanent occlusion of the ICA by the balloon technique. Two months after stenting, the patient underwent an IFTB approach, and gross total tumor removal was achieved. Having the ICA wall rein-

forced by a stent allowed for relatively safe manipulation of the artery to control its whole circumference and reduce the risk of injury of the vessel. The main risks associated with a stenting procedure are distal embolization and thrombosis,[32] none of which occurred in this patient. The rate of recurrence is relatively high even after total tumor removal, and it can occur many years after treatment.[5,17] Hence, prolonged follow-up in these patients is necessary. Overall recurrence rates have been reported between 8% and 53%.[5,11,17,19] In our series, recurrent tumors appeared in 15.3% of patients. It should be noted that recurrence has been seen up to 17 years after surgery.[11]

Some authors propose radiotherapy as a primary treatment for chondrosarcomas and report results equivalent to those of surgery and adjuvant radiotherapy,[10,14] but the efficacy of radiotherapy in long-term tumor control is still unknown, and further randomized controlled studies with longer follow-up are necessary. Furthermore, valid statistical comparisons between radiotherapy and surgery are difficult to make because of the small number of cases, both in our study and in the literature. In our opinion, the risks of radiotherapy (ie, brain necrosis, radiation-induced tumor, malignant transformation) should be well balanced against its potential benefits in such slow-growing tumors. Like Oghalai et al,[19] we usually do not recommend primary radiotherapy as the primary treatment for patients with skull base chondrosarcomas because of the difficulty in achieving tumor-free margins during surgical salvage of patients in whom primary irradiation fails. However, primary radiotherapy may be considered as an alternative treatment in selected cases in which there are serious medical contraindications to surgery, as well as in elderly patients. Adjuvant treatments (preoperative and/or postoperative) such as proton beam radiotherapy, stereotactic radiotherapy (gamma knife or Cyber knife), and fractioned radiotherapy have been successfully used.[12,14,33] Postoperative irradiation is usually recommended in patients with a high risk of recurrence (tumors more aggressive than grade I), as well as for residual and recurrent tumors.[5,11] In our series, all patients with histologically aggressive tumors (grade II or III) had postoperative radiotherapy. Postoperative radiotherapy was also administered to the 2 patients who had recurrence.

CONCLUSIONS

Chondrosarcomas of the skull base are rare tumors and represent an important diagnostic challenge. We believe that the primary treatment for chondrosarcomas of the skull base is gross total surgical resection of the tumor. It is our philosophy to reserve postoperative radiotherapy for patients with tumors more aggressive than grade I, as well as for cases with subtotal resection or recurrent tumor. We usually do not recommend radiotherapy as the primary treatment for patients with skull base chondrosarcomas. However, radiotherapy may be considered as an alternative primary treatment in selected cases in which there are serious medical contraindications to surgery, as well as in elderly patients.

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