Preoperative staging and surgical approaches for sinonasal inverted papilloma

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Abstract

Objectives: To determine the value of preoperative staging by magnetic resonance imaging (MRI) assessment in the surgical management of sinonasal inverted papillomas (IPs).
Methods: Preoperative MRI staging was used to assess 22 IP patients. In addition to the Krouse staging system, T3 diseases were categorized as subgroup T3-B if tumors extended into the frontal sinus or the supraorbital recess, otherwise they were categorized as T3-A. Standard endoscopic sinus surgery (ESS) was the first choice for T1 and T2 cases. Endoscopic approaches, including ESS combined with endoscope-assisted transantral approach and endoscopic medial maxillectomy, were considered in T3-A cases, while external approaches were considered in T3-B cases. Patients were followed for a minimum of one year after surgery.
Results: Preoperative MRI staging and postoperative staging were coincident in 21 of the 22 (95%) patients. All 8 T2 patients were treated by an endoscopic approach. Of 10 T3-A cases, nine (90%) were treated by an endoscopic approach and one (residual case) was treated by an external approach. All three T3-B patients underwent an external approach. One T4 case with malignant transformation underwent an external approach followed by radiotherapy. After a median follow-up period of 22 months, none of the 22 patients suffered recurrence. No major complications were observed after endoscopic approaches, but epiphora or hemorrhage requiring transfusion occurred in three of the five (60%) patients who underwent external approaches.
Conclusion: Preoperative staging of IP by MRI is useful for selecting patients who can be managed by endoscopic approaches, resulting in lower tumor recurrence and morbidity.

Introduction

Sinonasal inverted papilloma (IP) is a rare but locally aggressive benign tumor. IP tends to recur after surgical resection, and is occasionally associated with squamous cell carcinoma (SCC). Most recurrent cases, especially those which reoccur within two years, are residual diseases caused by inadequate removal of the tumor during surgery [1]. Until the development of endoscopic sinus surgery (ESS), open external approaches (such as medial maxillectomy via lateral rhinotomy or midfacial degloving) were recommended for the treatment of IP. Recently, advances in endoscopic surgical techniques and technology have led to a less invasive endoscopic approach to the surgery of IP [1-4]. In particular, endoscopic surgery has been applied to tumors involving the maxillary sinus by the introduction of an endoscopic medial maxillectomy (EMM) or an endonasal Denker operation [5, 6]. Recurrence rates following endoscopic surgery are reported to be comparable to those of more aggressive procedures [1-4]. However, the rates differ significantly among institutions and vary between 0% and 33% (mean of 15%) [4], suggesting that they should be interpreted with caution.

To determine an adequate approach to surgery, an IP staging system based on the extent and location of the tumor has been advocated. Krouse proposed a four-stage system taking into account the degree of invasion of the tumor into the paranasal sinuses and associated malignancies [3, 7] (Table I). According to this staging system, an endoscopic approach would be recommended for T1 and T2 stages of IP, while T3 lesions may be managed endoscopically in selected cases. Recently, several authors have reported the IP recurrence rate at each clinical stage according to the staging system [8-14]. However, no prospective study has examined the preoperative clinical stage and the choice of surgical approaches in IP. We previously reported that a magnetic resonance imaging (MRI) assessment of IP accurately predicts the extent of tumor involvement [15] and, since 2002, we have selected an endoscopic or an external approach according to the preoperative stage determined by the MRI assessment. The present prospective study analyzes the choice of surgical approaches and treatment outcomes in a series of IP cases and discusses the staging systems available.

Patients and Methods

Patients with exophytic papillomas usually originating from the nasal septum, and those diagnosed with IP and SCC in the preoperative pathological examination were excluded from this study. However, cylindrical cell papillomas (oncocytic Schneiderian papillomas), which have a similar clinical behavior to true IPs, were included. A total of 30 patients were treated for sinonasal IP between January 2002 and February 2006 at the Department of Otolaryngology-Head and Neck Surgery, Hokkaido University Hospital, Japan. The preoperative diagnosis of two cases was inflammatory nasal polyps, so MRI was not performed and they were excluded from the study. No tumor recurrence was observed in either case. In six patients, surgery was performed for recurrent IP and they were also excluded from the study. The remaining 22 patients (15 males and 7 females) ranged in age from 28 to 68 years (mean, 57 years; median, 59 years).

Pathological diagnosis was confirmed by biopsy, and preoperative MRI was performed as described previously [15]. T1-weighted, T2-weighted, and gadolinium-enhanced T1-weighted images were examined. Coronal images and axial images were obtained from all patients, and sagittal images were obtained if the tumor extended to the frontal sinus or sphenoid sinus. In addition, the presence of bone erosion at the skull base or the orbit was assessed by computed tomography.

Preoperative clinical stages were graded according to the Krouse staging system [3, 7] (Table I). In addition, T3 diseases were divided into the subgroups T3-A and T3-B. Tumors extending into the frontal sinus or the supraorbital recess were categorized as T3-B, otherwise they were categorized as T3-A. Standard ESS was the first choice for T1 and T2 cases. Endoscopic surgery, including ESS, ESS combined with endoscope-assisted transantral approach (ESS+TA), and endoscopic medial maxillectomy (EMM), was the method of choice for T3-A. However, external surgery was selected for T3-B cases because the frontal sinus and the supraorbital recess are difficult to access through endoscopic procedures and are frequent sites of recurrence [13, 14, 16]. Patients who underwent endoscopic resection with ESS+TA were classified into the endoscopic subgroup [4]. Treatment of T4 patients was assessed on a case by case basis. All patients were informed about our treatment policy and patients who underwent endoscopic surgery were informed in advance that external surgery would be required if the tumor was not completely excised.

All surgeries were performed under general anesthesia. In the lateral rhinotomy approach, *en bloc* medial maxillectomy with sphenoethmoidectomy and partial excision of the medial orbital wall were performed under assistance of an endoscope or a microscope to completely excise tumors around the lamina papyracea and the tegmen of the ethmoid sinus. In standard ESS, a powered microbrider was used to debulk tumors and the attachment of the tumor was identified and removed with the normal adjacent mucosa. We then examined pathological specimens after collecting tissues from the suction bottle [17]. The middle turbinate was excised according to the extent of the tumor but the inferior turbinate was left intact. We used an intraoperative image-guided system (StealthStation®, Medtronic Sofamor Danek, Co., Ltd., Minneapolis, MN) to assist in excising tumors around the lamina papyracea and the tegmen of the ethmoid sinus.

Most of the ESS+TA procedure was performed under an endoscope. In addition to the standard ESS approach, a canine fossa puncture was created as small as possible to prevent postoperative numbness of the cheek. Tumors involving the maxillary sinus were excised using a powered microbrider, Rosen elevators or curettes through the canine fossa puncture. In EMM, the posterior two thirds of the inferior turbinate with the medial wall of the maxillary sinus were removed down to the nasal floor, thus preserving the nasolacrimal duct. If the tumor extended around the nasolacrimal duct or the anterior wall of the maxillary sinus, the whole medial wall of the maxillary sinus including the nasolacrimal duct was removed.

In all surgical procedures, the bone underlying the tumor attachments was removed, curetted, or drilled by a diamond burr. Frozen sections were examined when tumor involvement was suspected in the tissues around the surgical margin. All patients were postoperatively examined by endoscope every one to three months during the first year and every six months thereafter.

Table I. IP staging system used in the study.

stage	Tumor description
T1	Limited to the nasal cavity
T2	Limited to the ethmoid sinus and/or the medial and superior portions of the maxillary sinus
T3	Involving the lateral, inferior, anterior, or posterior walls of the maxillary sinus, the sphenoid sinus, or the frontal sinus
(T3A)	Without extension to the frontal sinus or the supraorbital recess
(T3B)	Involving the frontal sinus or the supraorbital recess
T4	Extending outside the sinonasal cavities (orbital or intracranial extension) or associated with malignancy

Stages T1 to T4 were graded according to the staging system of Krouse [3, 7].
In addition, T3 diseases were divided into the subgroups T3-A and T3-B in this study.

Table II. Tumor involvement into paranasal sinuses and adjacent area.

Site of involvement	No. of cases (%)
[T2 sites]	
Ethmoid sinus	
Maxillary sinus (medial and superior walls)	
[T3-A sites]	
Maxillary sinus (lateral, inferior, anterior, or posterior walls)	
Sphenoid sinus	
[T3-B sites]	
Frontal sinus	
Supraorbital recess	
[T4 sites]	
Skull base	
Orbit	

Results

•Tumor sites, staging, and histology.

Tumor involvement of the paranasal sinuses and the adjacent area was determined by postoperative surgical and pathological findings (Tables II,III). The ethmoid sinus was the most frequent site of involvement (18/22, 82% patients), followed by the maxillary sinus (17/22, 77%). T2 papilloma was found in 8 patients (36%), T3 in 13 (59%), and T4 in one (5%) patient. There was no T1 papilloma in this study. Of the 13 T3 patients, 10 were categorized as T3-A and three as T3-B. Preoperative MRI staging and postoperative staging were coincident in 21 of the 22 (95%) patients. Postoperative pathological examination revealed IP with SCC in one T4 patient who was preoperatively diagnosed as stage T3-B by MRI findings. The remaining 21 patients didn't show severe dysphasia or SCC.

•Choice of surgical approach and recurrence.

All 8 T2 patients underwent an endoscopes approach (seven ESS and one ESS+TA). A transantral approach was required in one of these cases as the tumor had extended anteriorly to the medial wall of the maxillary sinus around the nasolacrimal duct (Figure 1). Nine of the 10 T3-A cases (90%) were treated by an endoscopic approach: four by ESS+TA, three by EMM, and two by ESS (Figure 2). In one T3-A patient who had undergone ESS at another hospital one month previously and was referred to us for the treatment of a residual tumor, an external approach via lateral rhinotomy was selected because the tumor was located around the lamina papyracea and the tegmen of the ethmoid sinus with scar formation. All three T3-B patients underwent a lateral rhinotomy approach (Figure 3). As the tumor did not widely extend to the frontal sinus, osteoplastic frontal sinusectomy was not required for these T3-B patients. One T4 patient with IP and SCC initially underwent medial maxillectomy via lateral rhinotomy and osteoplastic frontal sinusectomy as the preoperative MRI diagnosis suggested T3-B. Malignant transformation was demonstrated postoperatively and residual tumor was suspected in the contralateral frontal sinus, so the patient received further treatment of a bilateral frontal sinusectomy via a coronal incision followed by radiotherapy (40 Gy). The follow-up period ranged from 12 to 56 months (mean, 27 months; median, 22 months). None of the 22 patients suffered recurrence at the time of writing.

•Complications.

According to the classification advocated by May and Levine [18], epiphora and hemorrhage requiring transfusion were the major complications we experienced. Epiphora occurred in two T3 patients who underwent an external approach via lateral rhinotomy; a dacryocystorhinostomy was performed in these two patients but epiphora persisted in one patient. One T4 patient received a blood transfusion after a lateral rhinotomy and osteoplastic frontal sinusectomy. Other major complications, such as orbital hematoma, diplopia, or cerebrospinal fluid leakage, did not occur in the present series. Therefore, the occurrence of major complications was statistically higher in the patients who underwent an external approach (3/5, 60%) compared with those who underwent an endoscopic approach (0/17, 0%) (p=0.0065, Fisher's exact test). Regarding minor complications, one patient who underwent ESS had postoperative epistaxis requiring packing and electrocoagulation. Numbness of the cheek was observed in three of five (60%) patients who underwent ESS+TA.

Table III . Tumor staging and surgical approach in 22 patients.

Stage	Surgical approach	No. of patients
T2 (n=8)	ESS	7
	ESS+TA	1
T3-A (n=10)	ESS+TA	4
	EMM	3
	ESS	2
	Medial maxillectomy via LR	1
T3-B (n=3)	Medial maxillectomy via LR	3
T4 (n=1)	Medial maxillectomy via LR →Bilateral frontal sinusectomy via coronal incision+RT	1

ESS, endoscopic sinus surgery; ESS+TA, ESS combined with endoscope-assisted transantral approach; EMM, endoscopic medial maxillectomy; LR, lateral rhinotomy; RT, radiotherapy.
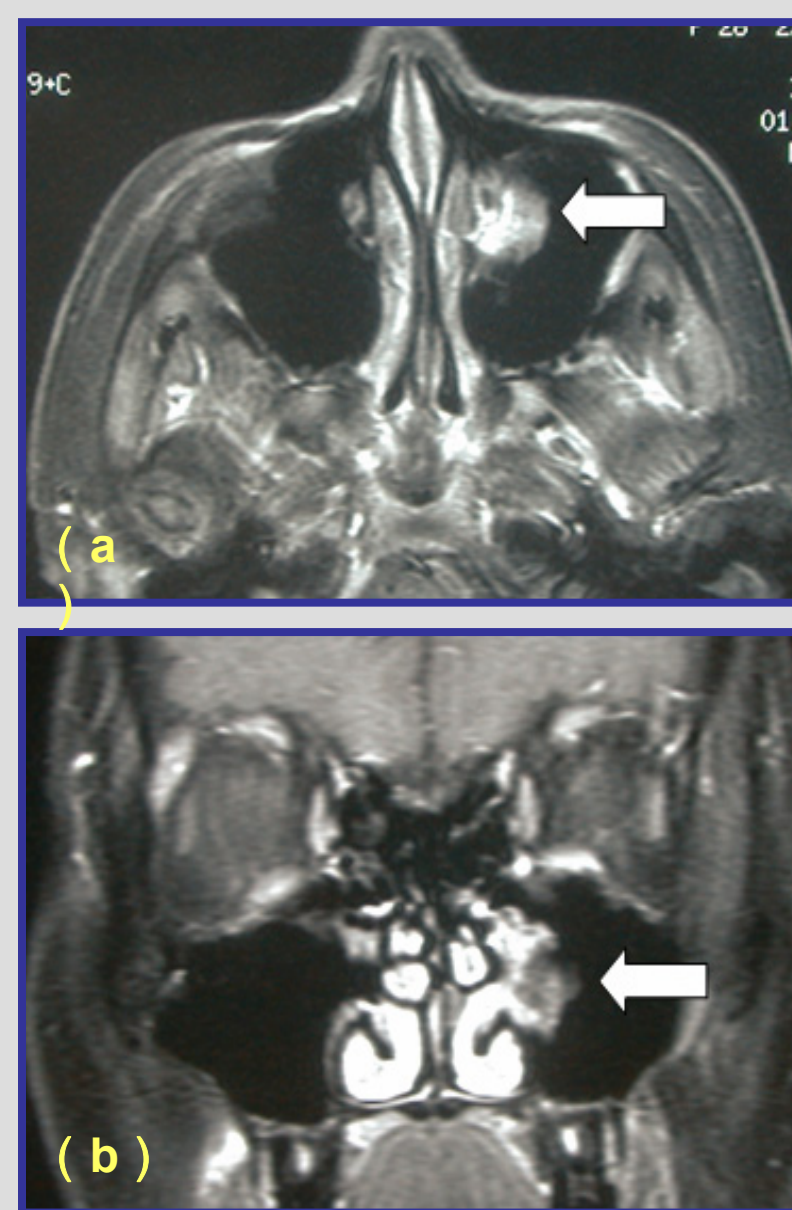

Figure 1.
T2 tumor that was treated by ESS+TA. Axial gadolinium-enhanced T1-weighted MR image (a) and a coronal image (b) show a tumor (arrowed) extending anteriorly to the medial wall of the maxillary sinus around the nasolacrimal duct.
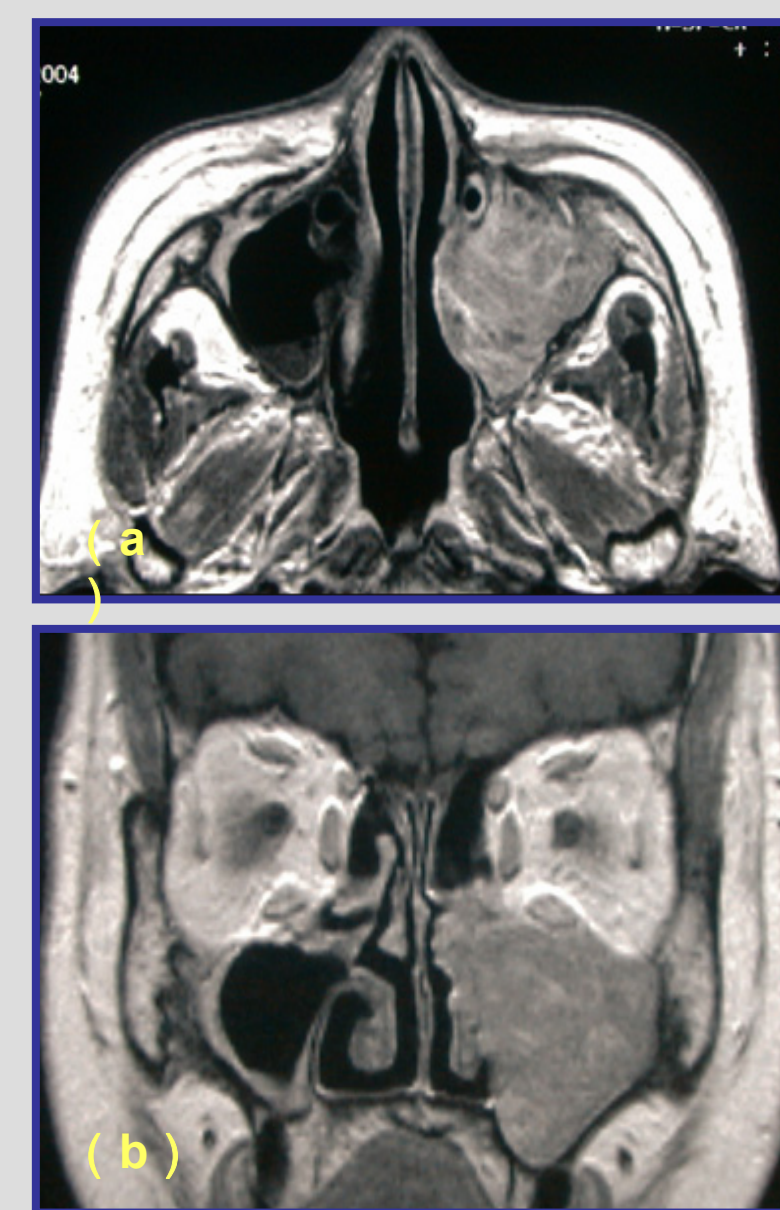
Figure 2.
T3-A tumor that was treated by ESS+TA. Axial gadolinium-enhanced T1-weighted MR image (a) and a coronal image (b) show a tumor that filled the entire maxillary sinus.
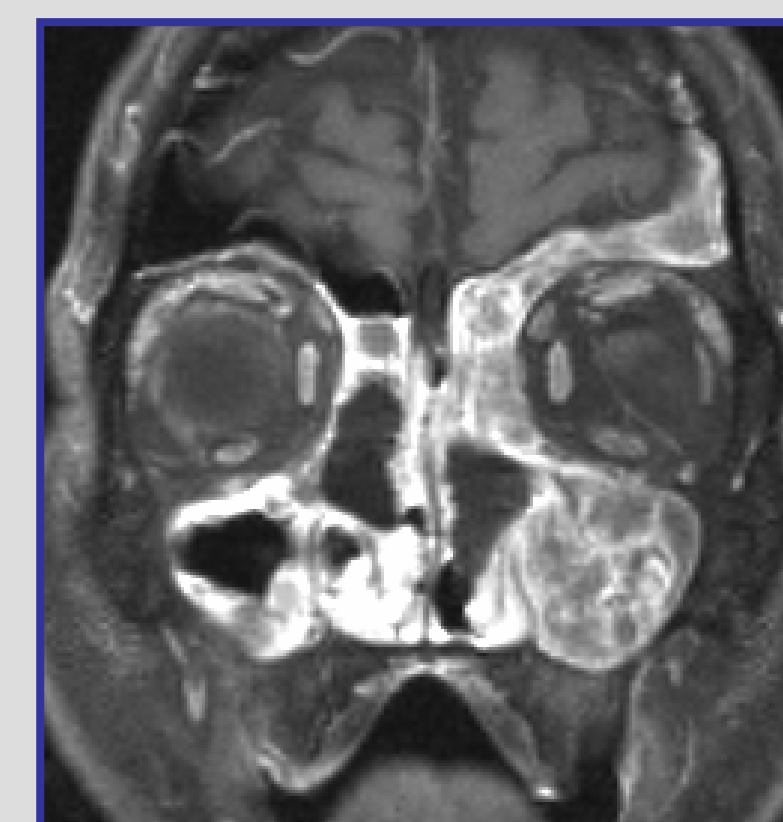
Figure 3.
T3-B tumor that was treated by an external approach via lateral rhinotomy. A coronal gadolinium-enhanced T1-weighted MR image shows a tumor extending to the frontal sinus that filled the entire maxillary and ethmoid sinus.

Conclusions

The present study shows that preoperative staging of IP, especially by MRI, is useful for selecting patients who can be managed by endoscopic approaches, resulting in lower tumor recurrence and morbidity. To prevent recurrence of IP, careful consideration should be given to the selection of endoscopic approaches for patients with stage T3 extension.

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