Inverted Papilloma: Evaluation with MR Imaging

The authors examined the magnetic resonance (MR) appearance of inverted papillomas to determine if this histologically benign lesion could be distinguished from malignancies of the sinonasal cavity. MR images in 10 patients with histologically proved inverted papilloma were retrospectively reviewed. The signal intensity of inverted papillomas on short repetition time (TR) images was iso- to slightly hyperintense to muscle in all 10 patients. Inverted papillomas had intermediate signal intensity on the long TR/echo time (TE) images. The tumors were iso- or slightly hypointense to fat on long TR/short TE images. In the seven patients who received gadopentetate dimeglumine, all inverted papillomas showed solid inhomogeneous enhancement. A review of eight sinonasal malignancies showed no distinctive signal intensity or enhancement characteristics to help differentiate inverted papillomas from various malignant tumors. The authors conclude that there is no signature MR appearance for the benign inverted papilloma. The main utility of MR imaging is in defining the extent of the lesion.

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Several recent studies have attempted to differentiate the lesions that occur in the sinonasal cavity by means of magnetic resonance (MR) imaging signal intensity characteristics and enhancement patterns (1–3). In general, inflammatory masses can be distinguished from malignancies by their very high signal intensity on T2-weighted images. In the sinonasal cavity, a peripheral rim-enhancement pattern has been described in inflammatory mucosal disease, polyps, and mucoceles (3). A solid enhancement pattern is suggestive of malignancy. Elsewhere in the head and neck, it has been suggested that less cellular neoplasms of the parotid gland can be distinguished from more cellular, poorly differentiated counterparts on the basis of signal intensity; the less differentiated lesions tend to have a lower signal intensity on T2-weighted images (4–6).

The inverted papilloma (IP) is a relatively common neoplasm of the nasal cavity, accounting for 4% of all nasal neoplasms (7). IPs generally arise along the lateral aspect of the nasal cavity but often grow into the paranasal sinuses and can be locally destructive. The importance of diagnosing IPs lies in the fact that squamous cell carcinoma may be coexistent in 5.5%–27% of cases (7–11). It is not clearly understood whether squamous cell carcinomas arise within IPs or in separate sites. It would be very useful to distinguish the two neoplasms because a more aggressive therapeutic intervention at the outset would be indicated for squamous cell carcinoma. The prognostic implications and the necessity of postoperative radiation therapy are different for the two entities.

To determine whether MR imaging is useful in differentiating between IP and sinonasal malignancies, we retrospectively reviewed the MR imaging experience with IP at two institutions. Our goal was to describe the appearance of IP at MR imaging and compare these characteristics with those of sinonasal malignancies reported in the literature.

MATERIALS AND METHODS

The MR images of all patients with histologically proved IPs from two institutions were retrospectively reviewed by three neuroradiologists (D.M.Y., D.W.F., S.J.Z.). The study population consisted of 10 patients (seven men and three women) aged 35–70 years (mean, 54 years). The nasal cavity was involved in all 10 patients; extension into the paranasal sinuses was seen in eight. Two patients had bilateral sinonasal extension.

All images were obtained at 1.5 T with a Signa imager (GE Medical Systems, Milwaukee) with a quadrature head coil. T1-weighted images were obtained with repetition times (TRs) of 400–850 msec and echo times (TEs) of 11–30 msec. Long TR images were obtained with TRs of 2,500–3,600 msec and TEs of 18–36 msec (proton density) and 80–108 msec (T2 weighted). Fast spin-echo (rapid acquisition with relaxation enhancement [RARE]) T2-weighted pulse sequences were used in three patients (12). All images were obtained with a 256 × 128–256 matrix, inferior saturation pulses, and one or two signals averaged. Gadopentetate dimeglumine was administered at a dose of 0.1 mmol/kg in seven of the 10 patients. T1-weighted images were obtained immediately after administration of the gadopentetate dimeglumine, with TRs and TEs of 600–833 and 17–26 msec, respectively.

Images were evaluated for signal intensity and contrast enhancement characteristics. The signal intensity of the IP was compared with that of muscle, fat, mucosa, and cerebrospinal fluid (CSF) for the T1-weighted, proton-density, and T2-weighted images. Because fat has high signal intensity on fast spin-echo T2-weighted images and intermediate signal intensity on routine spin-echo images, im-
The extent of disease was confirmed with review of surgical notes. In two patients, the masses extended through the cribiform plate to the intracranial compartment. No infraparenchymal cerebral invasion was present; however, meningeal infiltration was seen at surgery. The intracranial extent of the tumor was not appreciated at computed tomography (CT) performed in these two cases at the same time as MR imaging. In one case, the mass grew into the masticator space via the pterygopalatine fossa.

One patient underwent extensive preoperative biopsies, which led to a diagnosis of IP. The postoperative surgical specimen revealed multifocal microscopic areas of squamous cell carcinoma within the IP (Fig 3). Even in retrospect, none of the three neuroradiologists could identify the one patient with both squamous cell carcinoma and IP.

In 1 year, eight patients with malignancies of the sinonasal cavity (three esthesioneuroblastomas, two melanomas).
mas, two squamous cell carcinomas, and one small cell carcinoma) underwent MR imaging with similar parameters as those performed for the IPs. An informal review of these cases by one neuroradiologist revealed that three olfactory neuroblastomas (Fig 4), one melanoma, one squamous cell carcinoma, and a small cell carcinoma (Fig 5) had some of the same signal intensity characteristics and enhancement patterns as those of the IPs reported herein. The septated/striated appearance noted in five IPs was found in one squamous cell carcinoma and one olfactory neuroblastoma. The signal intensity patterns of IP and sinonasal malignancies are also compared with those reported in the literature in the following discussion.

**DISCUSSION**

IPs are masses that typically arise along the lateral nasal wall or in the paranasal sinuses (most frequently in the maxillary antrum). Patients present with nasal congestion, epistaxis, nasal discharge, and recurrent sinusitis. IPs originate from the nasal septum in only 5.5%-18% of cases (9,13). Bilateral IPs occur in less than 5% of cases (8). Men are three to five times more commonly affected than women, and whites are more commonly affected than blacks (7,8,11,13). The typical age range is 40-60 years, although IPs in the nasal septum often occur at a younger age (10,14-16). The etiologic characteristics of IPs are unknown, although an association with human papillomavirus-11 has been proposed (11).

The IP is seen pathologically as a vascular mass with prominent mucous cyst inclusions interspersed throughout the epithelium and a high intracellular glycogen content (8,17). The IP gets its name because of its unusual growth pattern into the underlying stroma rather than in an exophytic direction. IPs have been called by many names, including endophytic papilloma (to suggest its growth pattern), squamous cell papilloma, transitional cell papilloma, cylindrical epithelioma, inverted papilloma, and Schneiderian papilloma. The terms used for the exophytic papillomas are fungiform (most common) or cylindrical cell (rare) papillomas (8,17). Fungiform papillomas tend to occur on the nasal septum. Cylindrical cell papillomas favor the maxillary sinus (8).

Squamous cell carcinomas may be associated with IPs in 5.5%-27% of patients (7-11,18). Other neoplastic

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**Figure 2.** Right nasal IP in a 48-year-old woman. (a) Axial T2-weighted MR image (2,700/108) through the maxillary antrum reveals a mass of heterogeneous signal intensity within the right maxillary antrum and right nasal cavity, with well-defined borders. Intermediate signal intensity on T2-weighted images is not always indicative of high-grade malignancy. (b) Fat-suppressed coronal MR image (750/26) obtained after administration of contrast material reveals a solidly enhancing mass occupying the right nasal cavity and right maxillary antrum.
forms, such as mucoepidermoid carcinoma, verrucous carcinoma, and adenoid cystic carcinomas, have also been reported to coexist with IP. Malignant change of an IP has a weak association with human papillomavirus-16 (11). Because of the association of IP and squamous cell carcinoma and the very high recurrence rate of IP (15%–78%) (7,8,10,11,15,18), complete surgical extirpation is the treatment of choice. This is usually accomplished by means of lateral rhinotomy and en bloc excision of the lateral nasal wall (7,15,19). Midfacial degloving procedures may be an option that has improved cosmetic results; however, recurrence rates are still reported to be 22%–29%, even with lateral rhinotomy and midfacial degloving (18).

When the IP is far advanced and entering the intracranial space, craniofacial resection may be required, with a combined neurosurgical-otorhinolaryngologic team (18,19). The morbidity of craniofacial resection must be weighed against the benefit of completely removing the lesion. If an imaging modality could enable accurate prediction of the presence and location of a coexistent malignancy, surgical planning would be greatly aided.

Unfortunately, we have found that the signal intensity characteristics and enhancement pattern of IP are identical to those reported with squamous cell carcinoma (1–3,19). We could not distinguish IP from olfactory neuroblastomas, melanomas, or small cell carcinomas. Nor could we identify the IP with squamous cell carcinoma within it. Although calcification may occasionally be seen in IPs and would be a useful finding in an intranasal mass (usually limiting the diagnosis to an olfactory neuroblastoma and IP), in the one patient in whom this was present at CT, we were unable to identify the calcification with MR imaging. (The presence of increased attenuation on CT scans may not be a result of dystrophic calcification but may be reactive change along residual ethmoid sinus septa.)

Som et al (20) have previously reported that the pattern of bone destruction of IP may be identical to that of suprasellar cell carcinoma, particularly in the sphenoid and frontal sinuses and along the anterior cranial fossa. Bone destruction has been reported in up to 30% of IPs and is presumed to be due to pressure necrosis (7,20,21). The presence of bone destruction is better evaluated with CT than with MR imaging; in the region of the cribiform plate, where the bone is sieve-like, tumor can extend intracranially with only minimal osseous changes.

Differentiation of IP from inflammatory disease may be more successful in routine cases in which the inflamed mucosa has low signal intensity on T1-weighted images and very high signal intensity on T2-weighted images. The signal intensity of IPs was never as high as that of benign inflamed mucosa or obstructed secretions. Nonetheless, it has been shown that hyperproteinaceous sinonasal secretions may have a variable signal intensity that may overlap the intensity pattern of IPs (22). The solid enhancing pattern of the IP may distinguish it from inflamed mucosa and/or mucoceles, which have peripheral rim enhancement (3).

Minor salivary gland tumors and sarcomas of the sinonasal cavity have been reported to have high and low signal intensity characteristics with long TR pulse sequences (2,23,24). The premise that a mass with low signal intensity at T2-weighted imaging represents a poorly differentiated tumor (and, therefore, a poor prognosis) is fraught with exceptions, just as high signal intensity on T2-weighted images is not always indicative of benign tumors or inflammatory lesions.

Nonetheless, MR imaging is very useful in determining the location and extent of sinonasal neoplasms. In two cases, intracranial extent was not definitely suggested with CT. In one of these instances, the incorrect CT interpretation was a result of severe metal artifact from tooth amalgam. In the other case, infiltration was very subtle and was not visualized with CT because of its lower soft-tissue resolution.

There is no signature pattern of MR signal intensity characteristics or en-
hhancement suggestive of a specific diagnosis of IP. One cannot differentiate between patients with coexistent squamous cell carcinoma and those with IP.

References