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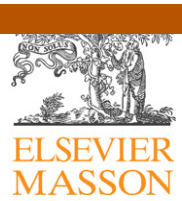

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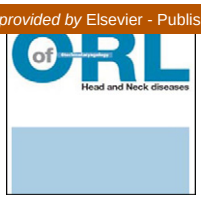

TECHNICAL NOTE

Interpretation pearls for MR imaging of parotid gland tumor

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Tumor;
MRI

Introduction

Parotid tumor pathology is complex, involving a wide variety of benign and malignant lesions that are hard to distinguish clinically. Indications for surgery depend on lesion histology, size and location. Parotid MRI and fine-needle aspiration cytology (FNA) are the two indispensable examinations to categorize and locate any parotid lesion showing an expansive aspect [1,2].

Etiologically, parotid masses correspond, in decreasing order of frequency, to:

- pleomorphic adenoma: a benign tumor requiring surgical dissection due to the two-fold risk of malignant degeneration and of recurrence, the frequency of which increases with lesion size and capsule defect;
- Warthin's tumor, or adenolymphoma, to which the attitude is becoming less and less frequently surgical, insofar as it can be reliably characterized on MRI or FNA; surgery, for reasons of esthetics or comfort, is reserved for forms that are voluminous or involve painful episodes of inflammatory evolution;
- low, intermediate or high grade malignant tumor, whether mucoepidermoid carcinoma, cystic adenoid carcinoma, adenocarcinoma, squamous cell carcinoma, undifferentiated carcinoma or lymphoma, for which the primary attitude is surgical;
- pseudotumor or rarer forms of benign tumor: lymphoepithelial cyst, oncocytoma, hemolymphangioma or lipoma.

MRI provides essential information for preoperative characterization of parotid lesions, if rigorously performed and interpreted [3].

Before deciding on surgery, the ENT physician should be as attentive to the quality of imaging as to the radiologist's diagnosis.

Technique

MRI should always be performed before FNA, due to the risk of bleeding incurred by the latter [4,5]: the blood in the lesion following hemorrhagic FNA interferes with the spontaneous lesion signal in T1-weighted sequences (spontaneous high signal intensity zone) and in T2-weighted sequences, impacts the diffusion coefficient as measured in the hemorrhagic areas and hinders uptake assessment following gadolinium injection.

MRI should comprise:

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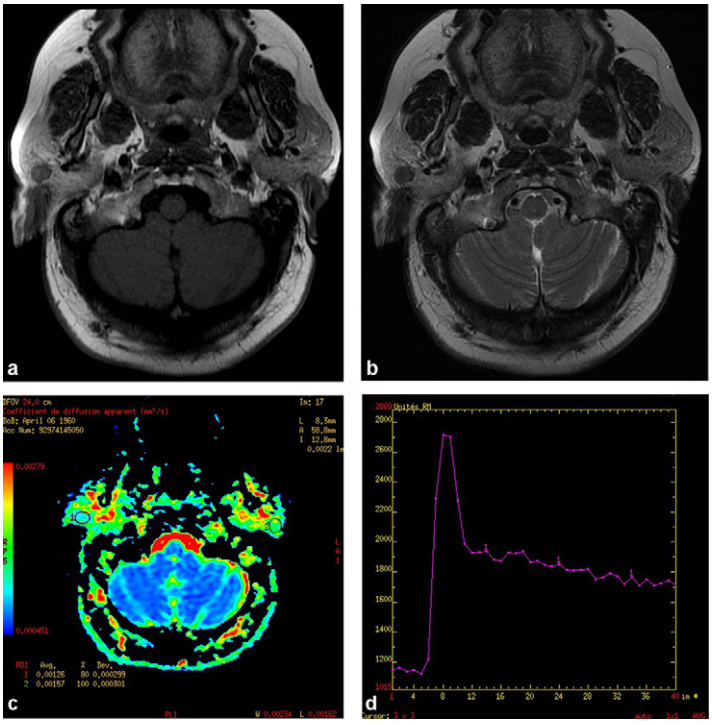

Figure 1 Warthin's tumor. 1 cm tissular lesion of the superficial right parotid: a: T1-weighted axial slice: lesion with high signal intensity on T1-weighted image; b: T2-weighted axial slice: lesion in low signal intensity on T2-weighted image; c: apparent diffusion coefficient map: ACDr = 0.8; d: perfusion curve showing rapid intense uptake with wash-out greater than 30%.

- a T1-weighted sequence to explore for spontaneous high signal intensity within the lesion, related to intralesional protein or hematic components, both indicating Warthin's tumor [6] (Fig. 1);
- a T2-weighted sequence without fat-saturation to compare signals between lesion and healthy parotid parenchyma: a clear high signal intensity zone in the former as compared to the latter indicates benign tumor

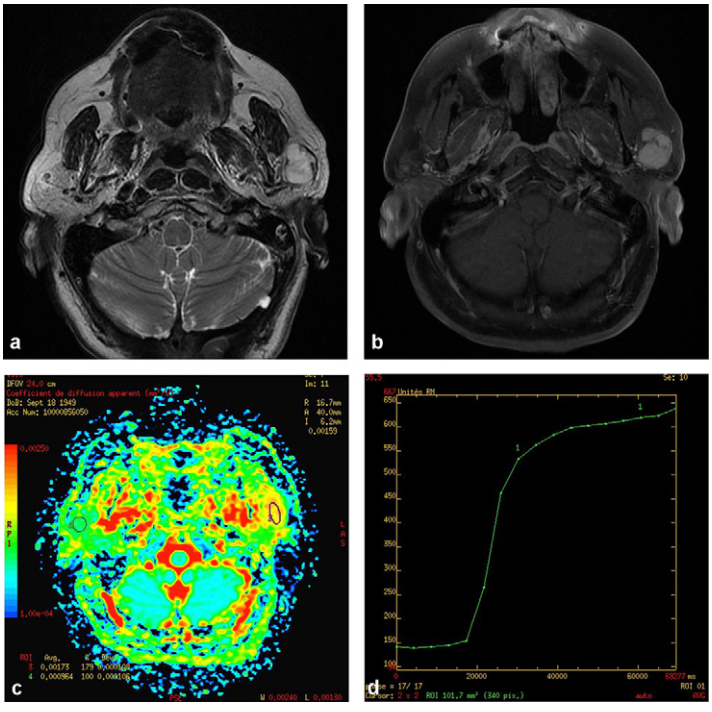

Figure 2 Pleomorphic adenoma. 35 mm tissular formation of the superficial left parotid: a: T2-weighted axial slice: clear high signal intensity on T2-weighted image; b: T1-weighted gadolinium-enhanced fat-sat axial slice: intense uptake; c: apparent diffusion coefficient map: ACDr = 1.7; d: perfusion curve showing intense uptake with ascending plateau.

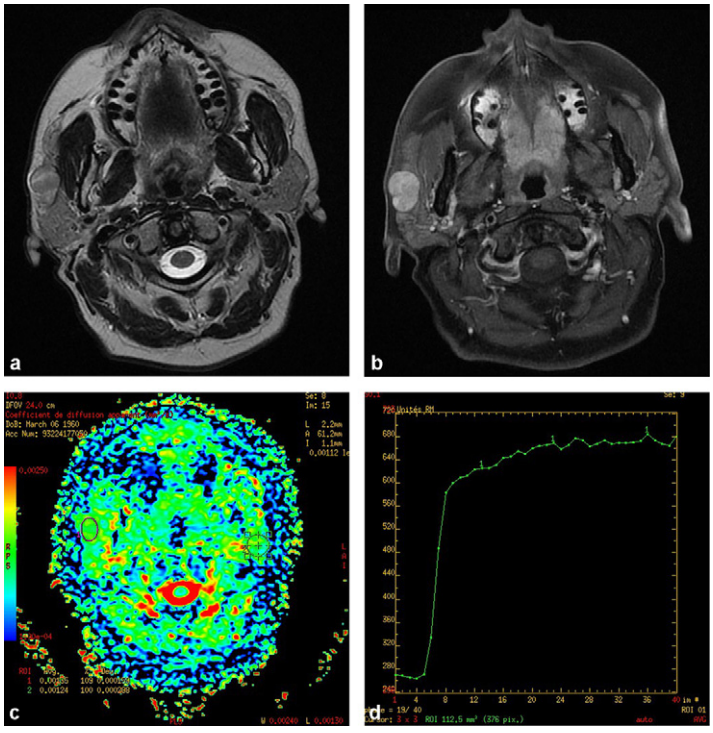

Figure 3 Cellular pleomorphic adenoma. 2 cm tissular formation of the superficial right parotid lobe: a: T2-weighted axial slice: lesion in isosignal on T2-weighted image; b: T1-weighted gadolinium-enhanced fat-sat axial slice: intense uptake; c: apparent diffusion coefficient map: ACDr = 1.09; d: perfusion curve showing intense uptake with ascending plateau.

(pleomorphic adenoma; Fig. 2); intermediate T2 signal intensity may indicate either cellular pleomorphic adenoma or intermediate grade tumor (Figs. 3 and 4); clear low signal intensity indicates malignant tumor [3] (Fig. 5);

- a diffusion-weighted sequence to study Brownian motion in the free water: lesions with multiple physiological barriers to motion of the free water (multiple cellular membranes in cellular tumor) limit diffusion and show

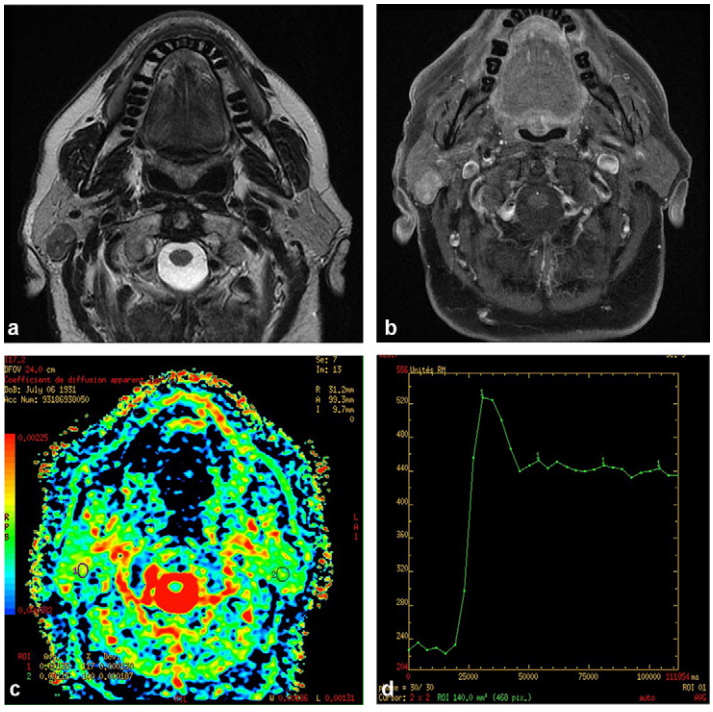

Figure 4 Intermediate-grade tumor. Tissular formation of the superficial right parotid: a: T2-weighted axial slice: low signal on T2-weighted image; b: T1-weighted gadolinium-enhanced fat-sat axial slice: moderate uptake; c: apparent diffusion coefficient map: ACDr = 1.1; d: perfusion curve showing early uptake with wash-out less than 30%.

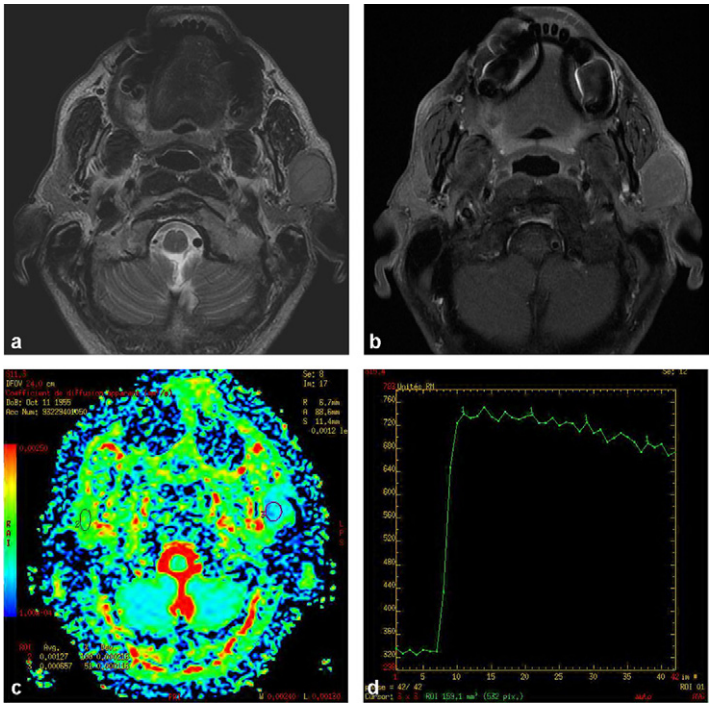

Figure 5 High-grade tumor. 3 cm tissular formation of the superficial left parotid lobe: a: T2-weighted axial slice: lesion in isosignal on T2-weighted image; b: T1-weighted gadolinium-enhanced fat-sat axial slice: moderate uptake; c: apparent diffusion coefficient map: ACDr = 0.5; d: perfusion curve showing descending plateau with wash-out less than 30%.

strong signal on diffusion-weighted sequences. The lesion signal should be compared to that of the neighboring or contralateral healthy parotid parenchyma, as an apparent diffusion coefficient ratio (ADCr: tumor ADC/healthy parotid ADC). Thus, clear a high intensity zone on a diffusion-weighted sequence with ADCr < 1 indicates high-grade malignancy (Fig. 5), while ADCr > 1.3 indicates a benign pleomorphic adenoma (Fig. 2); ADCr between 1 and 1.3 indicates either a cellular pleomorphic adenoma or intermediate-grade malignant tumor (Figs. 3 and 4) [3,7—9]; finally, ADCr approximating 0.5 indicates suspicion of lymphoma;

- a perfusion-weighted sequence — a dynamic sequence measuring gadolinium-enhanced signal intensity pixel-by-pixel over time. The resulting perfusion curve is a key element in lesion characterization: pleomorphic adenoma (regardless of cellularity) shows strong uptake with an ascending plateau (Figs. 2 and 3), while Warthin's tumor shows rapid intense uptake and intense wash-out, exceeding 30% (Fig. 1); intermediate-grade tumors show intense uptake with a horizontal or descending plateau and wash-out less than 30% (Fig. 4) [3,10,11];
- gadolinium-enhanced fat-sat T1-weighted sequences, to contour the lesion and distinguish cystic and tissular areas.

MRI report

The report should focus on:

- lesion morphology:
  - size and position (deep or superficial part of the gland), relation to the stylo-mastoid hole and retrocondylar veins (marking the facial nerve trajectory), contour quality and any extension into subcutaneous soft tissue and maseter muscle,
  - presence or absence of contralateral lesion,
  - presence or absence of adenopathies;
- lesion signal:
  - on T1-weighted sequence, T2-weighted sequence (without fat-sat), diffusion-weighted sequence with ADCr, uptake on gadolinium-enhanced fat-sat T1-weighted sequence, and perfusion sequence enhancement curve.

I.e., to provide all data required for lesion characterization, MRI must include the following three elements:

- a T2-weighted sequence (without fat-sat);
- a diffusion-weighted sequence with ADCr;
- a perfusion sequence with enhancement curve.

The MRI interpretation protocol should adhere to the decision tree shown in Fig. 6. The radiologist's diagnosis should match the lesion characteristics as presented in Table 1.

When MRI indicates typical adenolymphoma, FNA risks inducing an inflammatory episode and should not be performed: the lesion should be monitored on MRI only.

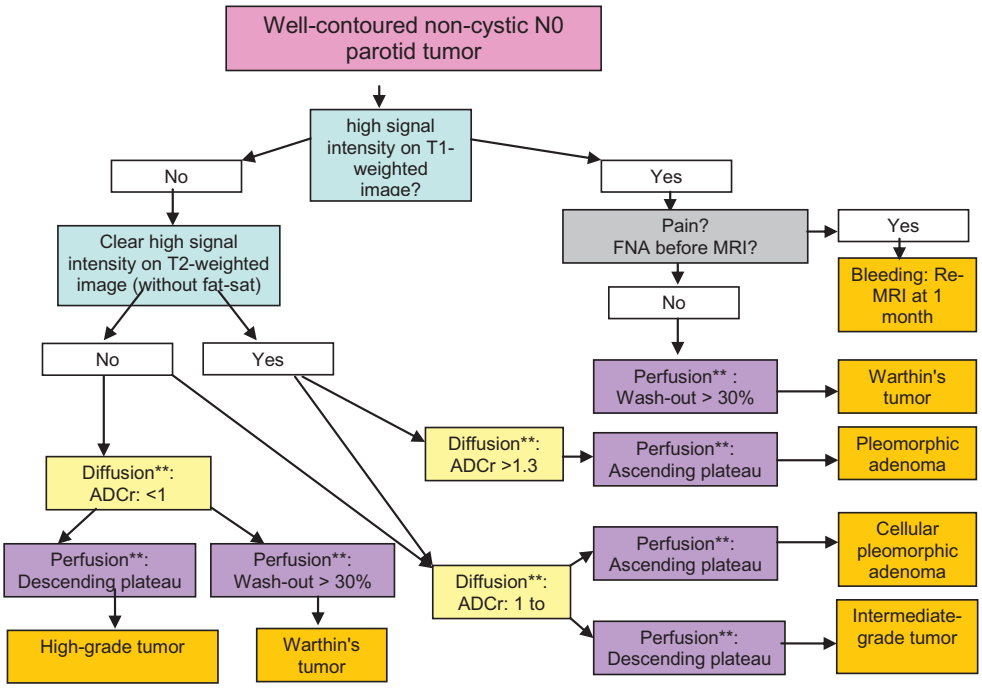

Figure 6 Decision tree for non-cystic parotid tumor without adenopathy.
*This decision tree excludes purely cystic tumors or tumors lacking an easily identifiable tissular component. ** On the perfusion and diffusion-weighted sequences, particular attention should be paid to the positioning of the region of interest within the tumor, which must be outside of the cystic areas.

Table 1 Lesion characteristics on MRI.

	T2	ADCr	Perfusion	Other
Warthin's tumor	Low or iso-signal intensity	Approx. 1	Wash-out > 30%	Hyper Bilateral Inferior pole Male > 50 yrs Smoker
Pleomorphic adenoma	High signal intensity	> 1.3	Ascending plateau	
Cellular pleomorphic adenoma	Iso-signal intensity	1 to 1.3	Ascending plateau	
Intermediate-grade tumor	Iso- or low signal intensity	1 to 1.3	Wash-out < 30%	
High-grade tumor	Low signal intensity	< 1	Descending plateau	Poorly contoured

Conclusion

Parotid MRI should comprise a T2-weighted sequence (without fat-sat), a diffusion-weighted sequence with ADCr and a perfusion sequence with enhancement curve.

Under these conditions, in more than 80% of cases MRI approximates histologic diagnosis of parotid lesions. When MRI indicates typical adenolymphoma, FNA is unnecessary and monitoring should be on MRI alone.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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