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MRI of ranulas

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Abstract We reviewed the MRI of 20 patients with a ranula (8 simple and 12 plunging) and ten with other cystic masses in the floor of the mouth and/ or suprahyoid portion of the neck (three haemangiomas, two neuromas, one monomorphic adenoma, one lipoma, two lateral cervical cysts and one dermoid cyst). Histological diagnoses were obtained in all cases with the exception of one presumed haemangioma. Ranulas were all well-defined, homogeneous masses giving low signal on T1-and markedly high signal on T2-weighted images. While simple ranulas were all confined to the sublingual space, plunging ranulas were centered on the submandibular space and tended to spill into one or more adjacent spaces. They extended into the sublingual space anteriorly (producung a so-called tail sign) in eight of 12 cases and into the parapharyngeal space superiorly in five. Although they sometimes filled a considerable part of the parapharyngeal space, displacement of surrounding muscles or vessels was usually slight, which was thought to reflect the nature of extravasation pseudocysts. All other cystic masses in our study had one or more MRI finding different from those of ranulas and could be easily differentiated from them.

Key words Mouth, cysts · Neck, cysts · Glands, salivary · Magnetic resonance imaging

Introduction

Ranulas are cystic lesions of sublingual gland origin which occur in the floor of the mouth. They can be classified into two types based on their extent: simple ranulas, confined to the sublingual space and plunging ranulas which extend into adjacent spaces. Most ranulas, whether simple or plunging, are pseudocysts without an epithelial lining [1, 2, 3, 4, 5]. In general, the optimal surgical approach for cystic masses in the floor of the mouth depends on the topographical relationship between the cyst and the mylohyoid muscle. Masses above the mylohyoid muscle are excised intraorally, whereas those below it require an extraoral approach [6, 7]. However, ranulas should be treated by excision of the sublingual gland via an intraoral approach regardless of their extent. Complete resection of the ranula itself has been shown to be unnecessary [1, 2, 3, 4, 5]. It is therefore essential to differentiate ranulas from other cystic masses prior to surgery, so as to select the optimal surgical approach.

Some workers have discussed the differential diagnosis of cystic masses in the floor of the mouth or suprahyoid region using CT [8, 9, 10]. Coit et al. [9] concluded that the diagnosis of a plunging ranula was strongly suggested by the "tail sign", a slight extension into the sublingual space with the bulk of the cyst seen in the submandibular space. The value of MRI has been reported in demonstrating the extent and internal architecture of a variety of cystic masses in this region and their relation to the surrounding structures [6, 11, 12, 13]. However, we think the contribution of MRI to differentiation of ranulas from other lesions has not been sufficiently discussed. Our purpose was to assess MRI characteristics of ranulas to differentiate them from other cystic masses in the floor of the mouth or suprahyoid regrion.

Methods

We studied 30 patients with cystic masses in the floor of the mouth or suprahyoid region examined by MRI:12 males, 18 females with a mean age of 34 years (range 6–69 years). The histological diagnoses were obtained by surgery in all cases with the exception of one haemangioma. There were 20 ranulas (eight simple and 12 plunging) and ten other cystic lesions (two neuromas, one monomorphic adenoma of the sublingual gland, three haemangiomas, one lipoma, one dermoid and two lateral cervical cysts). Clinically, all 30 lesions were soft, painless masses easily palpated in the floor of the mouth and/or suprahyoid region (Table 1). Of the 20 ranulas eight (six simple and two plunging) had recurred after excision or marsupialisation of ipsilateral ranulas and there was little clinical question as to the differential diagnosis. The other cases were all clinically diagnosed as benign cystic lesions and ranula was included in the differential diagnosis.

MRI was performed on a 1.5 T unit with a head and neck coil. T1-weighted spin-echo images were obtained in axial and/or coronal planes using parameters of 500–650/ 14 (TR/ TE ms) in all patients. T2-weighted fast spin-echo images (3000–5000/ 90 ms) were obtained in axial and coronal planes, with fat saturation in nine cases and without in 21. All images had a 256 × 192 matrix and 3–5 mm sections with a 0.3–1.0 mm interslice gap; superior and inferior presaturation pulses were applied for axial imaging. Intravenous contrast medium was used in two cases, a plunging ranula and a neuroma.

All images were interpreted independently by two oral and maxillofacial radiologists with regard to the extent, margins, internal architecture and signal intensity of the masses. Signal intensity was compared with that of normal structures on both T1- and T2-weighted images and classified as low (isointense with muscle), intermediate (higher than muscle, lower than fat), high (isointense with fat) and markedly high (higher than fat).

Results

The findings in the 30 cystic masses are shown in Table 1.

MRI findings in ranulas

All 20 ranulas were well-defined homogeneous masses and showed low or intermediate signal on T1- and markedly high signal, isointense with cerebrospinal fluid, on T2-weighted images. No ranula was midline. Simple ranulas were all confined to the sublingual space and even those less than 10 mm in diameter were easily detected on MRI (Fig. 1). On the other hand, plunging ranulas were centered on the submandibular space and likely to spill into one or more adjacent spaces. They extended slightly into the sublingual space (giving a tail sign) in eight of 12 cases, and this was clearly visible on MRI (Figs. 2, 3). Five plunging ranulas extended superiorly into the parapharyngeal space. While two out of these involved the space to only a minor extent, the others extended as far as the nasopharynx, filling a considerable part of the space. In all ranulas which extended into the parapharyngeal space, mass effect on surrounding structures, i. e., displacement of the pterygoid muscle, pharyngeal wall or internal carotid artery, was slight (Figs. 3, 4). Three plunging ranulas, two recurrent, were multilocular.

MRI findings in other cystic masses

All other cystic masses in our study had one or more MRI finding different from those of ranulas. Thus, two neuromas and a monomorphic adenoma, confined to the sublingual space, contained solid components and could be easily differentiated from ranulas. Three haemangiomas were all heterogeneous and two contained signal voids thought to represent phleboliths. A haemangioma extending into both the sublingual and submandibular spaces infiltrated into the muscles of the floor of the mouth (Fig.5). A lipoma showed high signal, isointense with subcutaneous fat, on both T1- and T2-weighted images. Two lateral cervical cysts were within the posterior aspect of the submandibular gland with or without extension into the posterior cervical space. One had signal intensity different from that of the ranulas. A dermoid cyst was confined to the submental space and had a heterogeneous internal architecture. No superior extension into the parapharyngeal space was found in any case.

Discussion

MRI findings in ranulas

MRI clearly showed simple ranulas of small size and the slight extension into adjacent spaces of plunging ranulas with signal intensity different from that of surrounding structures. To detail the extent of ranulas may not be essential for determining suitable surgical margins, because complete resection of the ranula itself is unnecessary [14]. However, the tail sign, the slight extension into the sublingual space of a cyst in the submandibular space, is a specific radiological feature of plunging ranulas originating from the sublingual gland [9, 15, 16]. The excellent ability of MRI to delineate the extent of the lesion was extremely helpful in detecting the tail sign and differentiating ranulas from other cystic masses. MRI clearly showed the tail sign in eight of 12 plunging ranulas, allowing the correct diagnosis. Of course, the tail sign can also be detected on CT. However, the sublingual space is a narrow, fat-filled space of low density similar to that of cysts on CT [16]. The wall

Table 1 Clinical and MRI findings in ranulas and other cystic masses in the floor of the mouth or suprahyoid region (*SLS* sublingual, *SMaS* submandibular, *PPS* parapharyngeal, *SMeS* submental, *PCS* posterior cervical spaces)

Case	Diagnosis	Clinical findings (site of swelling)		MRI findings			
		Oral cavity	Upper neck	Extension	Margins	Internal structure	Signal on T1-/T2-weighted images
1	Simple ranula	Yes	No	SLS	Well defined	Homogeneous	Low/markedly high
2	Simple ranula	Yes	No	SLS	Well defined	Homogeneous	Low/markedly high
3	Simple ranula	Yes	No	SLS	Well defined	Homogeneous	Low/markedly high
4	Simple ranula	Yes	No	SLS	Well defined	Homogeneous	Low/markedly high
5	Simple ranula	Yes	No	SLS	Well defined	Homogeneous	Low/markedly high
6	Simple ranula	Yes	No	SLS	Well defined	Homogeneous	Low/markedly high
7	Simple ranula	Yes	No	SLS	Well defined	Homogeneous	Low/markedly high
8	Simple ranula	Yes	No	SLS	Well defined	Homogeneous	Low/markedly high
9	Plunging ranula	Yes	Yes	SMaS, SLS, PPS	Well defined	Homogeneous	Low/markedly high
10	Plunging ranula	No	Yes	SMaS, SLS, PPS	Well defined	Homogeneous	Low/markedly high
11	Plunging ranula	No	Yes	SMaS, SLS, PPS	Well defined	Homogeneous	Low/markedly high
12	Plunging ranula	Yes	Yes	SMaS, SLS, PPS	Well defined	Homogeneous	Intermediate/markedly high
13	Plunging ranula	No	Yes	SMaS, SLS, SMeS	Well defined	Homogeneous	Low/markedly high
14	Plunging ranula	Yes	Yes	SMaS, SLS	Well defined	Homogeneous	Low/markedly high
15	Plunging ranula	Yes	Yes	SMaS, SLS	Well defined	Homogeneous	Low/markedly high
16	Plunging ranula	No	Yes	SMaS, SLS	Well defined	Homogeneous	Low/markedly high
17	Plunging ranula	No	Yes	SMaS, PPS	Well defined	Homogeneous	Low/markedly high
18	Plunging ranula	No	Yes	SMaS, SMeS	Well defined	Homogeneous	Low/markedly high
19	Plunging ranula	No	Yes	SMaS	Well defined	Homogeneous	Low/markedly high
20	Plunging ranula	No	Yes	SMaS	Well defined	Homogeneous	Low/markedly high
21	Neuroma	Yes	No	SLS	Well defined	Heterogeneous	Low/high or markedly high
22	Neuroma	Yes	No	SLS	Well defined	Heterogeneous	Low/high or markedly high
23	Monomorphic adenoma	Yes	No	SLS	Well defined	Heterogeneous	Low/predominantly markedly high
24	Haemangioma	Yes	No	SLS	Well defined	Heterogeneous	Low/predominantly markedly high
25	Haemangioma	No	Yes	SMaS	Infiltrative	Heterogeneous	Low/predominantly markedly high
26	Haemangioma	Yes	Yes	SMaS, SLS	Infiltrative	Heterogeneous	Low/predominantly markedly high
27	Lipoma	No	Yes	SMaS	Well defined	Homogeneous	High/high
28	Dermoid cyst	No	Yes	SMeS	Well defined	Heterogeneous	Low/predominantly markedly high
29	Lateral cervical cyst	No	Yes	SMaS	Well defined	Homogeneous	Low/markedly high
30	Lateral cervical cyst	No	Yes	SMaS, PCS	Well defined	Homogeneous	Intermediate/intermediate

of the ranula, delineating the boundary of the lesion, is often imperceptible on CT [8, 9, 17], so that slight extension of a ranula into the sublingual space may not be always identified. According to Coit et al. [9], CT revealed the tail sign in only two out of seven plunging ranulas. Although ours was not a comparative study, we believe that MRI is superior to CT for showing the tail sign, due to its excellent soft-tissue contrast.

Plunging ranulas also frequently extended into the parapharyngeal space (5/12 cases). Three extended su-

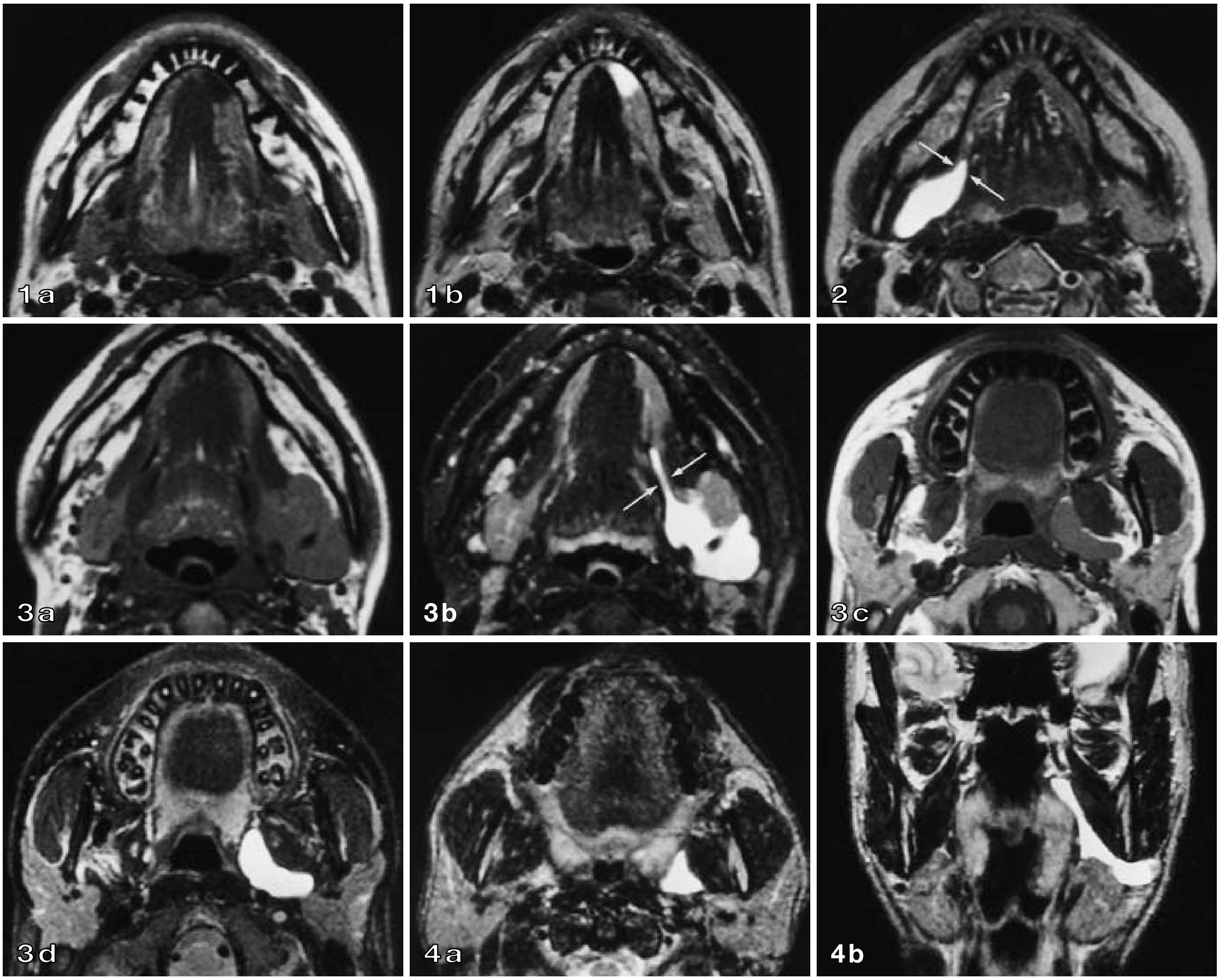

Fig. 1 a, b Simple ranula in a 36-year-old man. **a** T1- and **b** T2-weighted images reveal a small, well-defined mass confined to the left sublingual space. It gives homogeneous low signal in **a** and markedly high signal in **b**

Fig. 2 Plunging ranula in a 30-year-old woman. **A** T2-weighted image reveals a cystic mass in the right submandibular space with slight anterior extension into the sublingual space *(arrows)*. This appearance is the "tail sign", characteristic of plunging ranulas

Fig. 3 a–d Plunging ranula in a 20-year-old man. a, c T1- **b, d** T2-weighted images reveal a cystic mass in the left submandibular space extending into the sublingual space anteriorly *(***b** *arrows)* and into the parapharyngeal space superiorly (**c, d**). In the parapharyngeal space, extension of the mass appears to be restricted by surrounding muscles and/or vessels. Mass effect on these structures is slight

Fig. 4 a, b Plunging ranula in a 29-year-old man. T2-weighted images reveal a cystic mass in the left submandibular space showing a superior extension into the parapharyngeal space. Although the mass fills a considerable part of the latter, displacement of surrounding muscles and vessels is slight

periorly into the parapharyngeal space as far as the nasopharynx and filled a considerable part of the space. As there exists no fascial boundary between the sublingual/submandibular and parapharyngeal spaces, any lesion arising in the former can easily spread to involve the latter [9, 15]. Neveretheless the MRI features of ranulas in the parapharyngeal space would appear to be characteristic. Although no other lesion in our series involved this space, CT and MRI features of parapharyngeal space lesions have been covered in the literature. Masses extending into the parapharyngeal space cause medial bowing of the lateral pharyngeal wall as they enlarge [18], and displace the internal carotid artery posteriorly (deep-lobe parotid or minor salivary gland tumours) or anteriorly (tumours of neural origin) [19, 20] and, except for those of masticator space origin, displace the pterygoid muscles anteriorly [21]. In marked contrast to this, ranulas in the parapharyngeal space showed minimum displacement of those sur-

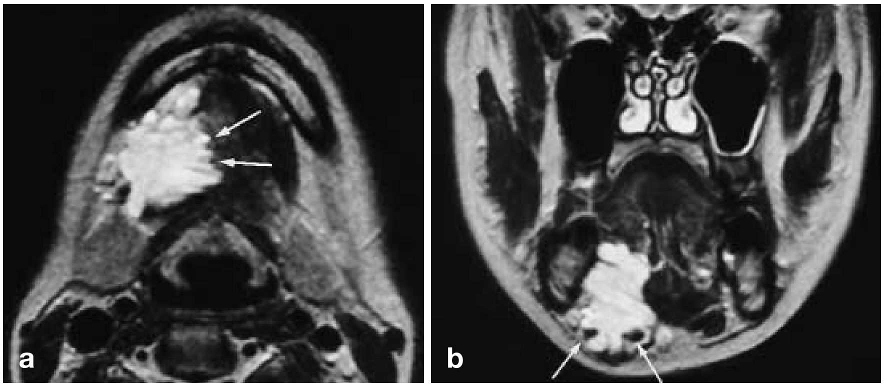

Fig. 5 a, b Haemangioma in a 44-year-old woman. T2-weighted images reveal a cystic mass extending into the right sublingual and submandibular spaces. It has ill-defined margins and infiltrates the muscles of the floor of the mouth *(***a** *arrows)*. The mass contains signal voids thought to represent phleboliths (**b** *arrows*)

rounding structures even when they filled a considerable part of the space. Plunging ranulas are pseudocysts resulting from the extravasation of saliva into the surrounding soft tissues [1, 2, 3, 4, 5]. When extending into the parapharyngeal space, such pseudocysts will spread along the loose fatty tissue (the parapharyngeal fat), the path of least resistance to growth, without displacing surrounding muscles or vessels. We thought the absence of significant mass effect on these structures reflected the nature of these extravasation pseudocysts and serve as a diagnostic signature, along with the tail sign.

MR findings of other cystic masses

Among the ten other cystic masses in our study, the diagnoses of a lipoma, two lateral cervical cysts and two haemangiomas with signal voids were suggested on the basis of their characteristic signal intensity, extent and internal architecture. Although a specific diagnosis was not suggested for the other five masses, the diagnosis of a ranula could always be excluded because all had heterogeneous internal architecture, not found in ranulas. We therefore thought MRI extremely useful for differentiating ranulas from other cystic masses. However, solid lesions can have a homogeneous, markedly high signal intensity similar to that of ranulas on unenhanced T2-weighted images [6,22,23]. Intravenous contrast medium may be necessary for nonspecific masses with a homogeneous cystic appearance on MRI.

The number of lesions in our series was limited. A variety of cystic masses can occur in this region besides those we encountered, such as thyroglossal duct cysts and lymphangiomas; the former are usually in the midline [7,8,9] and will therefore, mostly distinguishable from ranulas which occur laterally within the sublingual space. On the other hand, lymphangiomas are often found in the sublingual and submandibular spaces and, like ranulas, may involve multiple contiguous spaces [15,24]. Differentiation from ranulas can be accomplished on the basis of their heterogeneous internal contents, reflecting the presence of septa or fluid levels and by infiltrative margins, when present [25]. However, when these findings are absent, differentiation may not be possible.

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