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Case Report

Utility of 3D double-echo steady-state with water excitation (3D-DESS-WE) in diagnosing intraparotid facial nerve schwannoma: A case report ☆

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ABSTRACT

Differentiating intraparotid facial nerve schwannoma from other parotid tumors, particularly pleomorphic adenoma, is clinically crucial due to significant differences in treatment approaches. We report a case of a male patient in his 70s presenting with a left parotid mass. Magnetic Resonance Imaging (MRI) revealed a mass within the left parotid gland exhibiting the characteristic "target sign". The 3D double-echo steady-state with water excitation (3D-DESS-WE) MRI sequence demonstrated continuity between the mass and the facial nerve, a finding that significantly contributed to the diagnosis. Histopathological examination confirmed the diagnosis of schwannoma. This case highlights the potential of the 3D-DESS-WE sequence, in addition to conventional MRI signs, in improving the diagnostic accuracy of intraparotid facial nerve schwannomas.

Introduction

Schwannomas are tumors originating from Schwann cells of the nerve sheath. They can develop from peripheral nerves throughout the body and are typically observed as well-defined masses along the course of nerves. Intraparotid occurrences account for only 9% of facial nerve schwannomas and 0.2%-1.5% of all parotid tumors [1,2]. In clinical practice, diagnosing intraparotid facial nerve schwannoma often presents challenges. This difficulty arises from its low incidence, nonspecific clinical symptoms, and imaging findings that closely

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resemble other parotid tumors, particularly the pleomorphic adenoma. However, differentiation between these conditions is clinically important due to significant differences in treatment approaches. While conventional MRI sequences such as T1-weighted, T2-weighted, and diffusion-weighted imaging provide valuable information, they fall short in delineating the relationship between tumors and the facial nerve within the parotid gland. CT scans, while offering excellent spatial resolution, lack the soft tissue contrast necessary for distinguishing nerve tissues. Recently, the 3D Double-Echo Steady-State with Water Excitation (3D-DESS-WE) MRI sequence has been reported to excel in facial nerve visualization [3]. The 3D-DESS-WE sequence combines high spatial resolution with excellent tissue contrast, enabling visualization of fine neural structures that were difficult to observe with conventional imaging techniques. These makes 3D-DESS-WE particularly suited for assessing the relationship between parotid tumors and the facial nerve. We report a case where the 3D-DESS-WE sequence proved valuable in diagnosing an intraparotid facial nerve schwannoma.

Case presentation

A male patient in his 70s presented to our otolaryngology department with a 4-year history of a left parotid mass. Physical examination revealed a mobile, elastic soft mass approximately 3 cm in diameter in the lower part of the left parotid gland. The patient reported no tenderness, and there was no evidence of a facial nerve palsy.

Magnetic Resonance Imaging (MRI) demonstrated a well-defined, smooth-margined oval mass measuring approximately 2.6 cm in longest diameter within the left parotid gland. The lesion was located just below the stylomastoid foramen, corresponding to the region where the facial nerve is typically found. On T1-weighted imaging (T1WI), the mass showed homogeneous signal intensity similar to that of skeletal muscle (Fig. 1A). T2-weighted imaging (T2WI) and Short Tau Inversion Recovery (STIR) sequences revealed high signal intensity at the periphery and low signal intensity in the solid-appearing center, exhibiting a characteristic "target sign" (Figs. 1 B and C). The "target sign" refers to the appearance of the tumor on T2-weighted images, where it looks like a bulls-eye or target, with a bright outer ring and a darker center. This sign is characteristic of schwannomas [4] but can be seen in other tumors as well. T2WI also showed a low-signal-intensity rim suggestive of a capsule. No "string sign" was observed in any MRI sequence. The "string sign" describes how part of the tumor appears to extend into a specific opening in the skull (the stylomastoid foramen), looking like a string. This sign is particularly associated with facial nerve schwannomas [2]. Diffusion-weighted imaging (DWI) demonstrated high signal intensity, with an apparent diffusion coefficient (ADC) value of 1.4 $\times$ 10 $-$3mm2/s in the central portion of the lesion that appeared hypointense on T2WI (Figs. 1 D). The 3D-DESS-WE sequence revealed continuity between the mass and the facial nerve (Fig. 1 E and F).

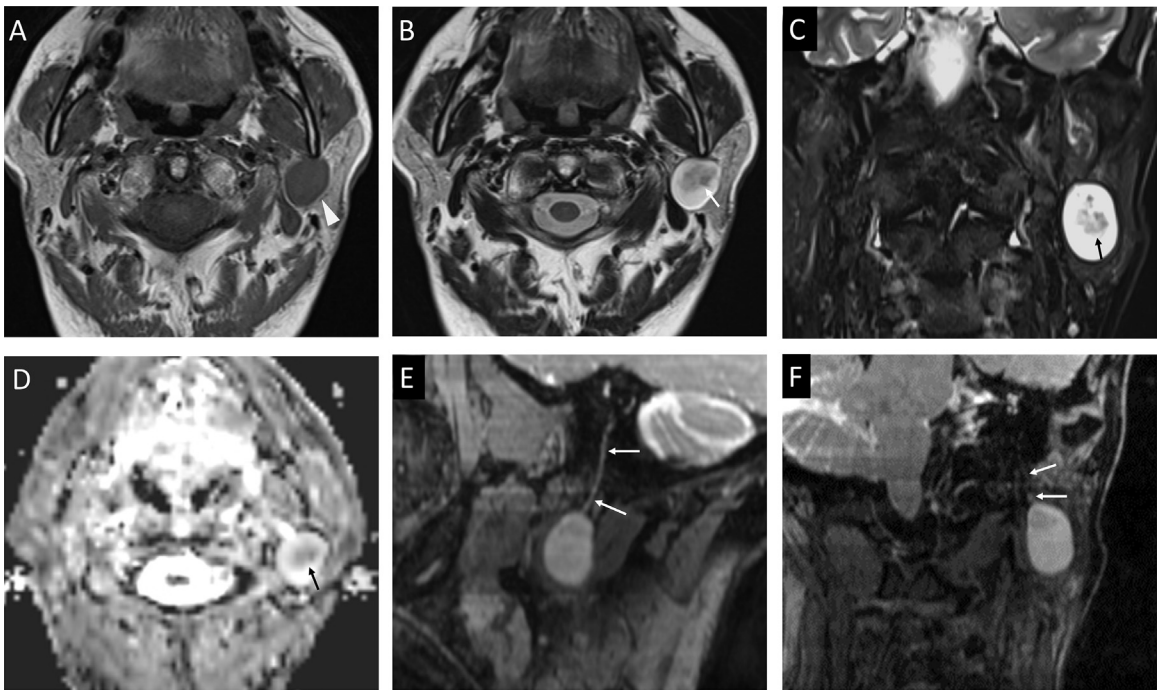

Fig. 1 – MR imaging findings. The known lesion (arrowhead) demonstrates low signal intensity on the T1-weighted axial image (A) T2-weighted axial image (B) and short tau inversion recovery (STIR) coronal image (C) show high signal intensity at the periphery and low signal intensity (arrows) in the center of the lesion. The apparent diffusion coefficient (ADC) map (D) reveals an ADC value of 1.4 x 10-3 mm2/s in the central portion of the lesion (arrow), which corresponds to low signal intensity region on T2-weighted image or STIR. The 3D double-echo steady-state with water excitation oblique-sagittal image (E) and oblique-coronal image (F) demonstrates continuity (arrows) between the mass lesion and the facial nerve.

While a preoperative diagnosis a schwannoma was considered, other parotid tumors such as pleomorphic adenoma could not be ruled out. The parotid tumor was surgically excised. Histopathological findings were consistent with a diagnosis of schwannoma.

Discussion

Facial nerve schwannomas can arise at any point along the facial nerve, but most commonly occur within the temporal bone. This rarity contributes to the diagnostic challenges. Furthermore, CT findings and fine-needle aspiration cytology are often nonspecific, making differentiation from pleomorphic adenomas difficult [5,6]. Preoperative differentiation between these entities is crucial as it significantly impacts treatment strategies.

While surgical excision is the standard treatment for pleomorphic adenomas, observation is generally recommended for intraparotid facial nerve schwannomas. This conservative approach is due to the non-negligible risk of facial nerve palsy associated with surgical removal of intraparotid facial nerve schwannomas [7]. Facial nerve palsy can significantly impair a patient's quality of life, underscoring the clinical importance of accurate preoperative diagnosis to avoid unnecessary surgery.

MRI plays a central role in diagnosing parotid tumors. The "target sign'' is a characteristic MRI finding in schwannomas, presenting as high signal intensity at the periphery and low signal intensity in the center on T2WI. This appearance reflects the histopathological composition of myxoid matrix at the periphery and high cellular density in the center [4]. The target sign has been reported to have 100% specificity and 59% sensitivity for schwannomas, making it a valuable diagnostic feature [4]. Additionally, Shimizu et al. described the "string sign,'' where part of the tumor protrudes into the stylomastoid foramen, as characteristic of facial nerve schwannomas [2]. However, as facial nerve schwannomas can occur at any point along the nerve, the string sign may not always be present, as in our case. This highlights the limitations of relying on a single imaging feature.

Compared to conventional MRI sequences, 3D-DESS-WE offers superior spatial resolution and contrast for visualizing nerves within soft tissues. While T1 and T2-weighted images can show the 'target sign' (sensitivity 59%, specificity 100%) [4], they often fail to clearly delineate the course of the facial nerve. CT scans, despite excellent spatial resolution, lack soft tissue contrast. In contrast, 3D-DESS-WE has shown high sensitivity in visualizing intraparotid facial nerves (100% for the main trunk, 48% for the temporofacial division, and 36% for the cervicofacial division) [8], potentially improving diagnostic accuracy for facial nerve schwannomas

The improved visualization of the facial nerve's relationship to parotid tumors using 3D-DESS-WE can significantly impact clinical decision-making. It may reduce the need for exploratory surgery, decrease the risk of inadvertent nerve damage during biopsies, and aid in surgical planning when intervention is necessary. This could potentially lead to improved patient outcomes, reduced surgical complications, and more informed discussions with patients about treatment options and risks.

The 3D-DESS-WE sequence can complement these conventional findings and potentially improve diagnostic accuracy. Kim et al. [8] reported high sensitivity in visualizing intraparotid facial nerves using the 3D-DESS-WE sequence, with 100%, 48%, and 36% visibility for the main trunk, temporofacial division, and cervicofacial division, respectively. In our case, the 3D-DESS-WE sequence clearly demonstrated continuity between the mass and the facial nerve, suggesting the tumor's origin from the facial nerve and increasing diagnostic confidence.

The advantage of the 3D-DESS-WE sequence lies in its high spatial resolution and tissue contrast, enabling the visualization of fine neural structures that are challenging to detect with conventional imaging methods [3]. In particular, it allows for the tracking of the facial nerve within the complex anatomical structures of the parotid gland. This facilitates a more detailed assessment of the relationship between tumors and nerves, providing valuable information for preoperative planning. However, this study reports on a single case, and further study involving a larger number of cases is necessary to generalize the utility of the 3D-DESS-WE sequence.

In our case, while the "target sign'' on conventional MRI suggested a schwannoma, the differential diagnosis still included pleomorphic adenoma. The 3D-DESS-WE sequence, by clearly demonstrating continuity between the mass and the facial nerve, significantly increased our diagnostic confidence. However, as surgical intervention was still deemed necessary due to the tumor's size and the patient's symptoms, the 3D-DESS-WE findings did not alter the immediate clinical management in this instance.

This article has several limitations. Firstly, as a single case report, its findings cannot be generalized. The diagnostic value of 3D-DESS-WE may vary in cases where the "target sign'' or "string sign'' are absent. Moreover, 3D-DESS-WE itself has limitations: it may not clearly visualize smaller nerve branches, and image quality can be affected by patient movement or dental artifacts. The technique also requires specific MRI capabilities and expertise in interpretation, which may not be universally available.

Future research should focus on validating these findings through larger, multicenter studies. Prospective studies comparing the diagnostic accuracy of 3D-DESS-WE with conventional imaging techniques for various parotid tumors would be valuable. Additionally, research into the impact of 3D-DESS-WE on surgical planning and patient outcomes could further establish its clinical utility. Efforts to optimize the technique for visualizing smaller nerve branches and reducing susceptibility to artifacts should also be pursued.

Conclusion

In the diagnosis of facial nerve schwannoma within the parotid gland, the evaluation of continuity with the facial nerve using the 3D-DESS-WE sequence, in addition to the conventional "target sign" and "string sign", may enhance diagnostic accuracy. This method may help avoid unnecessary

surgeries and contribute to determining appropriate treatment strategies, thereby potentially improving and maintaining the patient's quality of life. Future accumulation of cases is expected to further clarify the clinical utility of the 3D-DESS-WE sequence.

Patient consent

Patient consent was obtained from the patient.

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