Role of Ultrasound in the Imaging of Parotid Swellings

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Abstract

This pictorial essay details anatomy of the normal parotid as well as a spectrum of intra- and extraparotid pathology. Extraparotid lesions which mimic a parotid swelling are well characterised on ultrasound. In addition, sonographic features of intraparotid neoplasms, inflammation and infection are also illustrated. We recommend ultrasound as a useful first line approach in the evaluation of parotid disease, and also as an aid to guided biopsy of both intra- and extraparotid masses.

Introduction

When imaging a parotid swelling, it is necessary to determine if the lesion is intra- or extraparotid. Intraparotid lesions may be inflammatory or neoplastic, benign or malignant, solitary or multiple and lie superficial or deep to the facial nerve. Ultrasound (US) is particularly sensitive in the detection of focal lesions in the superficial portion of the gland. US guided fine needle aspiration and cytology (FNAC) may further enhance its ability to differentiate between intra/extraparotid lesions or predict the malignant/benign nature of a tumour. The main disadvantage of parotid US is in the evaluation of deep lobe lesions, parapharyngeal extension and skull base involvement.

Method

Real time scans of the parotid region were obtained using either a 5MHz or 7.5MHz linear array or 10MHz mechanical sector transducer with inset water bath (Aloka 650). Imaging of superficial parotid lesions was improved by using the linear 5MHz transducer with a 4 inch by 4 inch 3M stand-off pad, as this placed the lesion in the optimal focal zone of the transducer. Transverse and longitudinal (coronal) scans were performed with the patients supine and head turned away from the side being imaged. Transverse images were obtained with the transducer perpendicular and inferior to the ear lobe. When performing longitudinal scans, care was taken to angulate the transducer anteriorly in order to search for lesions in the tail of the parotid that would be obscured by the mandibular ramus.

Normal US Anatomy of the Parotid

The parotid gland is the largest of the salivary glands and is triangular in configuration. It demonstrates smooth, homogenous and fine bright echoes on US. Its major anatomical land marks on axial imaging are the masseter muscle and mandibular ramus anteriorly, the sternocleidomastoid muscle and mastoid process posteriorly, and the carotid sheath medially (Figure 1). Superiorly it extends to just below the level of the zygomatic arch. The facial nerve forms the boundary for the surgical division of the parotid gland into superficial and deep lobes. The nerve is however not visible on US, and its position is inferred as it parallels the course of the Stenson's duct through the gland (Figure 2). The retromandibular vein (branch of the external carotid vein) runs through the deep portion of the gland (Figure 3).

Figure 1: Axial image of right normal parotid demonstrating anatomical relations. Parotid gland (asterisk), masseter muscle (short arrow), mandibular ramus (long arrow), sternocleidomastoid muscle (open short arrow).

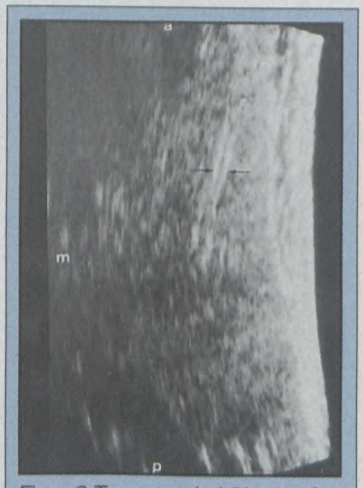

Figure 2: Transverse (axial) image of left parotid shows Stenson's duct as two parallel echogenic lines (arrows) coursing through the parotid.

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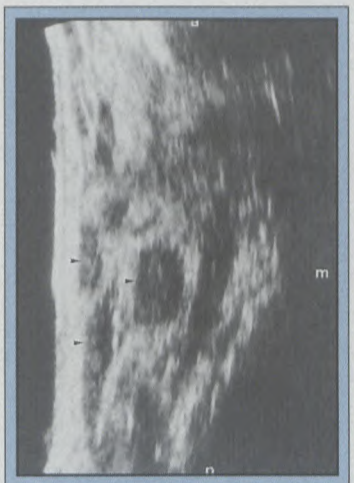
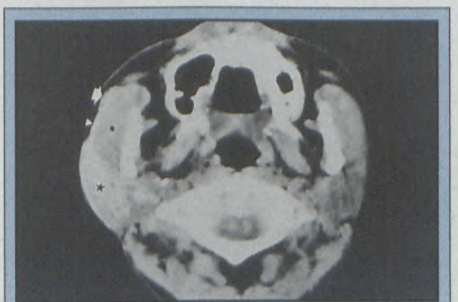


Figure 3: Longitudinal (coronal) image on the right demonstrates the retromandibular vein (arrows) in the deep portion of the parotid.

Intraparotid lymph nodes are normally not visible or very sparse and small except in children. There may be from 10 to 20. They drain into the superficial and deep cervical chains[1]. The accessory parotid gland is found adjacent to the parotid duct separate from the main body of the gland (Figures 4A,4B) and should not be mistaken for pathology.

Figure 4: Accessory parotid.

A. A sliver of parotid tissue (short arrow) is noted adjacent to Stenson's duct (arrowheads) and masseter muscle (asterisk) on axial US.



B. Corresponding axial CT/sialogram shows the accessory parotid (short arrow) superficial to the Stenson's duct (arrowhead) and masseter muscle (asterisk), separate from the main parotid gland (star).

Extraparotid lesions

Whether a parotid swelling is of intra- or extraparotid origin is important to the surgeon as the surgical approach differs for both lesions. Intraparotid lesions require a transparotid approach with localisation and control of the facial nerve, whilst extraparotid lesions may be approached perorally or via the submandibular region with no attempts at facial nerve control.

Masses arising from outside the salivary gland which mimic a parotid swelling show no rim of parenchyma surrounding them or a parenchymal beak. Examples include lymphadenopathy, branchial cysts, schwannoma, lipomas, neurofibromas, and masseter muscle pathology (Figures 5-9). All these were easily recognised and characterised on US except for the schwannoma, where US could only diagnose an extraparotid lesion, possibly of mesenchymal origin. US guided FNAC confirmed the diagnosis.

Intraparotid lesions

Intraparotid lesions usually show a visible rim of surrounding parenchyma on US or a beak sign. Retention cysts may occur secondary to inflammation or obstruction. They appear anechoic, cystic and well defined. Enlargement of intraparotid lymph nodes are well demonstrated on US and are normal in children. In adults, one has to consider viral infections like infectious mononucleosis (IMS) and cytomegalovirus (CMV), metastases, Sjögren syndrome and lymphoma.

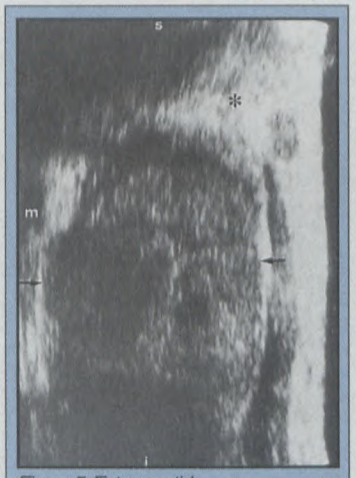


Figure 5: Extraparotid lymphadenopathy. Longitudinal sonogram of a patient with Letterer-Siwe disease shows a large solid malignant lymph node of the upper cervical chain (arrows) abutting the parotid (asterisk). Metastatic lymphadenopathy in the jugulo-digastric region, particularly from a primary head and neck malignancy, can also present as a parotid swelling.

Figure 6: Branchial cleft cyst - an embryological remnant of the second branchial cleft. Longitudinal sonogram of the lateral cervical region shows a large echo-free cyst with smooth inner walls.

Neoplasms

Eighty per cent of salivary gland tumours are found in the parotid gland, 80% of parotid tumours are benign and 80% occur in the superficial lobe.[2] The commonest benign neoplasms are the pleomorphic adenoma and the adenolymphoma (Warthin's cyst). Although the pleomorphic adenoma is more common in females and the Warthin's cyst more common in males, these tumours are often not easily distinguishable on US. They appear as homogenous, hypoechoic, well defined, occasionally lobulated or cystic masses, and may show posterior acoustic

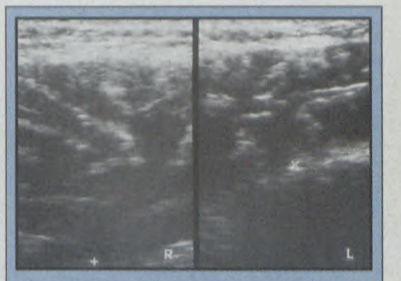


Figure 7: Masseter muscle hypertrophy. This is often idiopathic and occurs in adolescence and young adulthood. It can be unilateral or bilateral. Axial images of both masseter muscles show a marked discrepancy in thickness. The right masseter is hypertrophied.

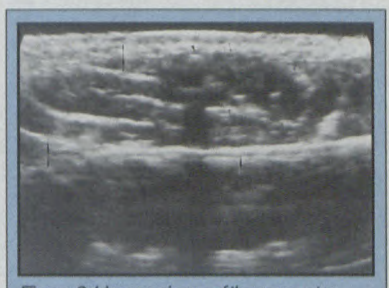


Figure 8: Hemangioma of the masseter muscle. Longitudinal (coronal) image shows two echogenic phleboliths with posterior acoustic shadowing (arrowheads) within the masseter muscle at the angle of the jaw.

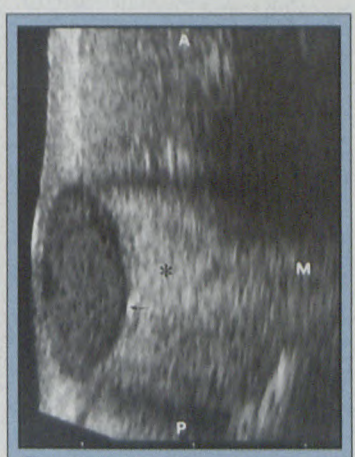


Figure 9: Schwannoma. Axial scan on the left shows a lobulated, well defined, solid, hypoechoic nodule (arrows) abutting the parotid (asterisk) in a patient with neurofibromatoses. FNA confirmed a schwannoma.

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enhancement (Figure 10). Pleomorphic adenomas may recur, and reportedly undergo malignant transformation in 2-5%[2,3]. Warthin's cyst occurs virtually only in the parotid gland[4], usually in the tail region. They arise from heterotopic salivary duct epithelium in the intraparotid lymph nodes, and hence can be multicentric (30-95%) and bilateral (30%)[5].

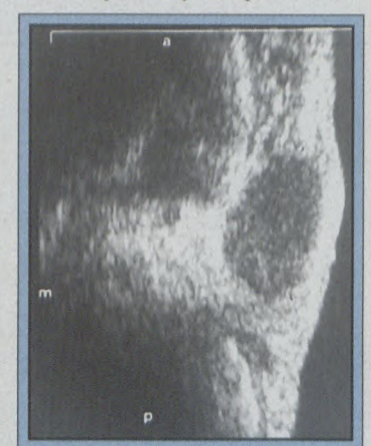


Figure 10: Pleomorphic adenoma. Axial sonogram shows a well defined, hypoechoic, homogenous lesion (arrows), with posterior through transmission of sound.

Malignant neoplasms are distinctly uncommon in the parotid. They account for less than 6% of salivary neoplasms and are more common in the minor salivary glands. The commonest include mucoepidermoid carcinoma (Figure 11), adenoid cystic carcinoma, malignant pleomorphic adenoma, lymphoma and metastases (e.g. squamous cell carcinoma, melanoma). US features of a malignant neoplasm are a hypoechoic, heterogeneous mass lesion with irregular, ill defined margins, and infiltration of adjacent tissues (Figure 12). Symptoms of pain and paraesthesia, facial nerve palsy, rapid increase in size and cervical lymphadenopathy should raise the suspicion of a more sinister lesion.

Figure 12: Adenocarcinoma of the parotid. An irregular, hypoechoic, inhomogenous lesion is seen involving both superficial and deep lobes of the parotid on transverse US. Its margins are irregular and poorly defined.

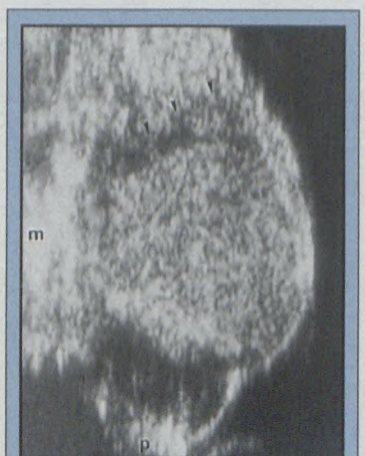


Figure 11: Mucoepidermoid carcinoma Axial sonogram shows a heterogeneous solid mass lesion (arrows) with areas of necrosis and relatively well defined margins (a known feature). A rim of residual normal parotid remains (arrowheads).

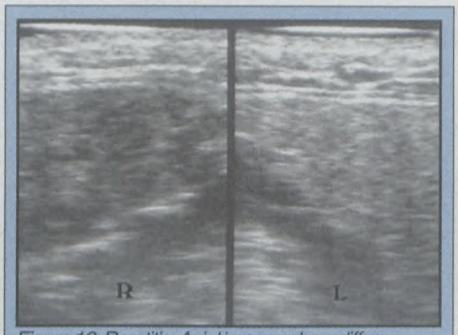


Figure 13: Parotitis. Axial images show diffuse marked homogenous hypoechogenicity of the right parotid compared to the left.

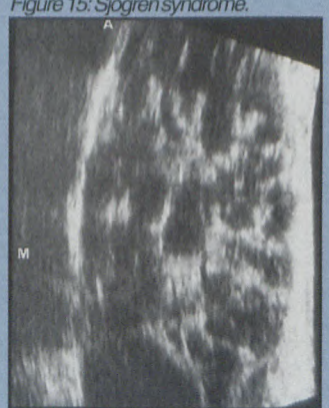
Inflammation

Inflammatory parotid enlargement can be secondary to: (1) Viral infection, e.g. mumps; (2) Bacterial parotitis, especially in diabetics, debilitated and post surgical patients; (3) Granulomatous conditions, e.g. tuberculosis, sarcoidosis; (4) Immune parotitis, particularly Sjögren syndrome.

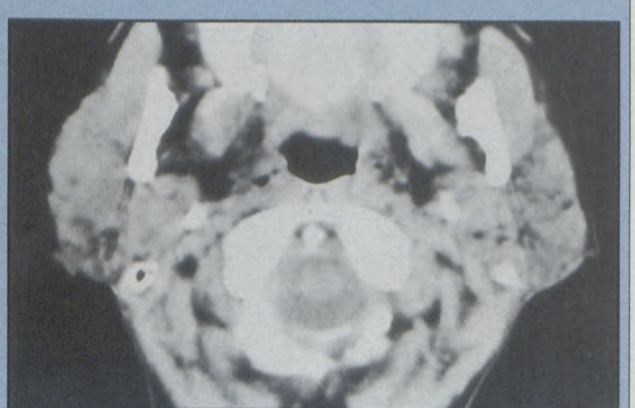
Figure 14: Parotid abscess. Longitudinal US shows a focal, hypoechoic, mass lesion (arrow heads) with ill defined posterior margin (arrow) in a patient who presented with a painful, tender parotid mass and fever.

Mumps parotitis causes diffuse, bilateral swelling of the parotids, which can be asynchronous (Figure 13). There is often associated cervical lymphadenopathy. Parotid abscess is seen on US as a focal, hypoechoic mass lesion that can be sharply circumscribed or have poorly defined margins, and can infiltrate beyond the parotid gland (Figure 14). Clinical correlation is vital in confirmation of an abscess. Immune parotitis is best illustrated by Sjögren syndrome which is a benign, chronic, systemic autoimmune disorder causing destruction of acinar tissue in exocrine glands. It occurs primarily in women aged 40 to 60 years, and presents classically with a triad of xerostomia, keratoconjunctivitis sicca and an associated connective tissue disorder, most commonly rheumatoid arthritis. Typical sialographic features are punctate spherical collections of contrast noted throughout the parotid gland. US demonstrates bilateral diffuse parotid enlargement with reticulated hypoechogenicity, with or without cystic change (Figures 15A,B,C).

Figure 15: Sjögren syndrome.



A. Transverse US shows multiple cystic and hypoechoic areas throughout the parotid gland. No normal parenchyma is seen.



B. Axial CT of the same patient shows bilateral symmetrical enlargement of the parotid gland, demonstrating soft tissue and low density areas within.

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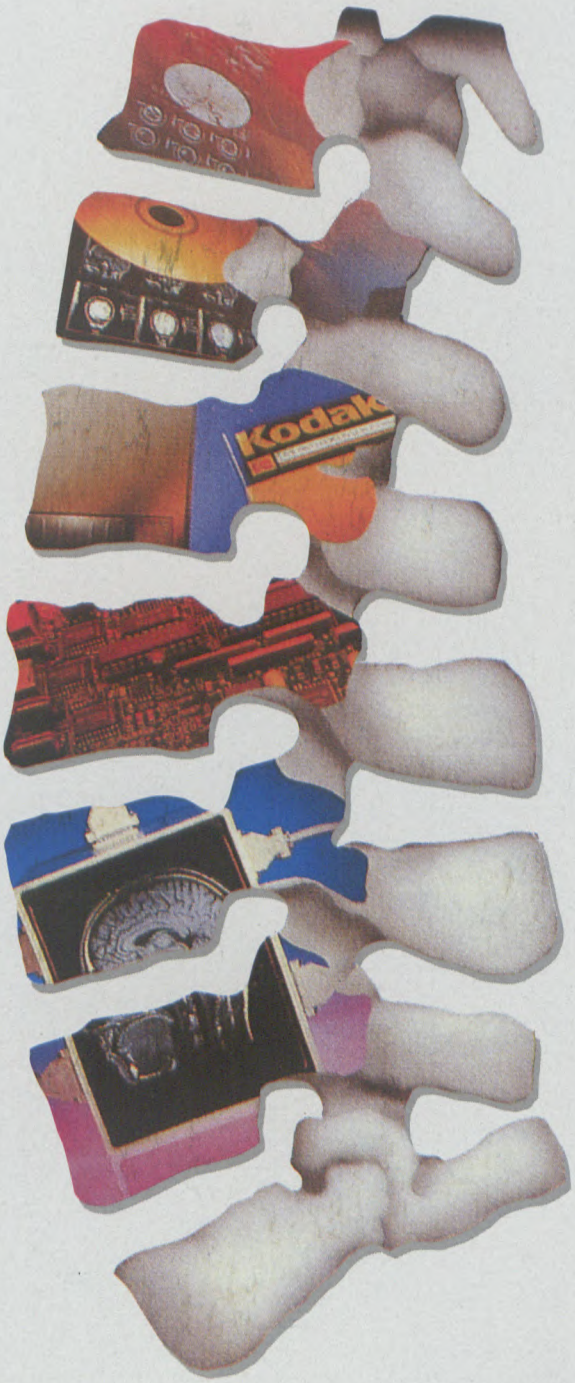
The backbone of imaging



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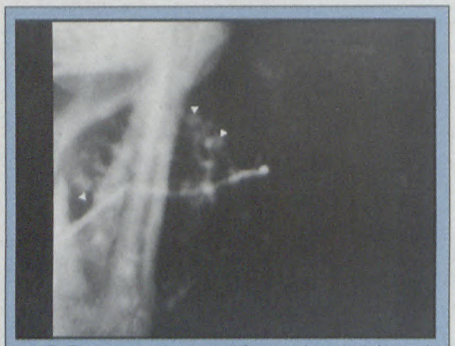
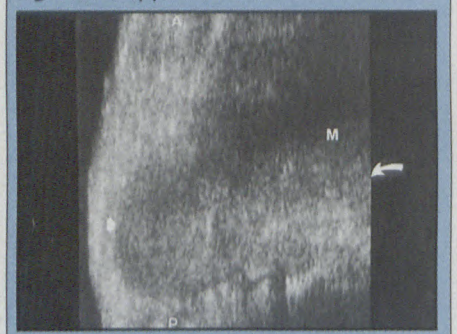
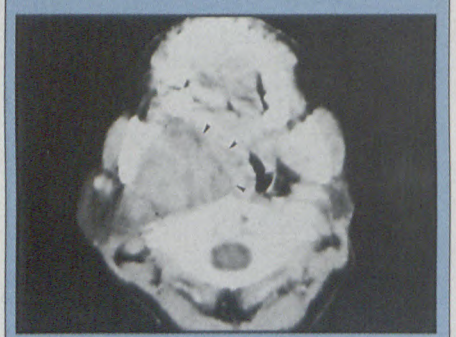


15 C. Sialogram shows mild to moderate sialectasia. Spherical collections of contrast medium (arrowheads) are noted throughout the gland.

Figure 16: Deep parotid lesion



A. Axial US shows an extensive, solid mass lesion involving the deep parotid (short arrow) without adequate delineation of the inner/medial margins (curved arrow).



B. Transverse CT reveals a massive lesion arising from the oropharyngeal region (arrowhead) and infiltrating the parotid gland (open short arrow). Biopsy showed oropharyngeal adenocarcinoma.

Associated lymphadenopathy should alert one to the possible complication of lymphoma, which signals a grave prognosis and is often rapidly fatal[6].

Conclusion

US remains an inexpensive, rapid and non-invasive technique for imaging of the parotid. Its ability to predict the histologic nature of a focal mass lesion may be further enhanced by US guided FNAC[7]. The major limitations of US are in the evaluation of deep lobe parotid lesions (Figure 16A,B), parapharyngeal extension and skull base destruction, when CT is the imaging modality of choice. Although magnetic resonance imaging offers excellent contrast resolution and multiplanar facilities in the delineation of parotid lesions, it is as yet equally unreliable in the prediction of the histology of a mass lesion[8], still not widely available and relatively expensive.

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