Ultrasound and guided fine needle aspiration cytology in the submandibular triangle

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Abstract

Objective. The aim of this study was to evaluate whether High Resolution Ultrasound (US) along with Fine Needle Aspiration Cytology (FNAC) can provide the surgeon with adequate preoperative information for masses in the submandibular triangle.

Subjects and methods. Eighty-two consecutive patients with suspected masses of the submandibular triangle had US with guided FNAC (49 patients) and final histological correlation (47 patients).

Results. Compared to final histology, US had a sensitivity of 97%, specificity 83%, positive predictive value 91% and a negative predictive value of 95% while FNAC had a sensitivity of 100%, specificity 90%, positive predictive value 94% and a negative predictive value of 100%.

Conclusion. US combined with a FNAC is an ideal initial investigation for evaluating masses in the submandibular area. It is quick, inexpensive, easily available, and provides the surgeon with relevant information preoperatively obviating the need for further expensive imaging.

Introduction

To a surgeon, a patient presenting with a mass in the submandibular triangle is a common clinical problem. Clinical examination alone is often unable to identify the nature and exact origin of the mass and imaging is necessary. Due to rising medical costs,

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the clinician is faced with the dilemma of choosing the appropriate initial investigation which is cost effective and provides the necessary information. Computed Tomography (CT), Magnetic Resonance Imaging (MRI) and Ultrasound are well established imaging modalities for this area, but which modality should be chosen for which problem?

Magnetic Resonance Imaging with its multiplanar imaging capability and a high spatial resolution without using ionizing radiation is often used as the first investigation for masses in the submandibular area. However its limited availability in many countries and high cost are major limiting factors. Computed Tomography involves the use of ionizing radiation, contrast medium injection and scans have to be done in more than one plane to provide adequate information. Also bone and metal artifact from dental work often degrade the image quality.

Ultrasound is inexpensive, quick, easily available and can be combined with a fine needle aspiration cytology (FNAC) thus increasing its specificity. It therefore appears attractive as an initial investigation of choice. However the sonologist must be completely familiar with cervical anatomy. The rapidity of ultrasound scanning, as well as the limited value of the sonogram to the less experienced mean that the examination should always be performed by a specialised person and the results are therefore operator dependent, a relative drawback.

Although the literature contains many reports and US descriptions of specific pathologies in the submandibular triangle, to our knowledge there is no report of how useful US might be in a series of consecutive unselected cases. We were therefore interested in re-examining the role of US and combined FNAC as an initial tool for diagnosis and further management.

Materials and methods

US was performed on 82 consecutive patients presenting with a suspected mass in the submandibular area. Submental masses which did not encroach into the submandibular triangle were excluded from the study. All scans were done with a 7.5 MHz linear transducer or with a 10 MHz mechanical sector scanner with an inset waterbath. Transverse and longitudinal scans of the submandibular area were performed with the patient supine and the head turned away from the side being examined. The rest of the neck and other salivary glands were routinely scanned in all cases with particular emphasis on the jugulo-digastric area and the tail of the parotid gland.

The ultrasound guided FNAC was done with a 21G needle, and multiple passes were made through different parts of the lesion. The specimen collected was sent to the laboratory in 25% alcohol, where the smears were made by the medical technologist.

For identifying abnormal lymph nodes by ultrasound the criteria we used were echogenicity, the presence of cystic or coagulation necrosis,[1] a short axis to long axis ratio (S/L ratio) greater than 0.5, [2] matting, oedema of adjacent soft tissues and abscess formation. Benign (either reactive or quiescent) nodes tend to be oval compared to malignant nodes which are round.[3] Nodes less than 5 mm in maximum transverse diameter were considered to be normal.[3] Nodes between 5-8 mm were considered benign whereas all nodes greater than 8 mm were considered malignant [4] and had a guided FNAC on the largest node.

In calculating the sensitivity, specificity, positive and negative predictive values for ultrasound and FNAC respectively, only patients with both US and histology and FNAC and histology were included in the analysis.

Results

The 82 patients ranged between 1-72 years of age and there were 45 males and 37 females. In 20 patients no abnormality was detected, 33 patients had glandular abnormalities and 29 patients had extraglandular lesions. Table I summarizes the spectrum of pathology we evaluated during the course of the study.

Tables II and III summarize the presumptive clinical diagnosis, FNAC diagnosis and the histologic diagnosis for intraglandular and extraglandular lesions.

In twenty patients no abnormality was detected on US. A detailed clinical examination was otherwise unremarkable and as the clinical index of suspicion for the submandibular area was also low no further imaging was performed. Subsequent follow up examinations in the outpatient department three to eight months later were also unremarkable in all these patients, suggesting the masses may have been reactive nodes which resolved prior to the patients having their ultrasound scans.

Nineteen patients had focal intraglandular masses; of these seventeen were benign and two malignant. Both the malignant masses were solid, ill defined, hypoechoic and showed

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Table I: Spectrum of pathology in the submandibular triangle

Number	FNAC		Histology	
	Diagnostic	Inadequate		
Intraglandular masses				
Benign				
Pleomorphic adenomas	16	14	2	16
Oncocytoma	1	1	-	1
Malignant				
Mucoepidermoid Ca	1	1	-	1
Adenoidcystic Ca	1	1	-	1
Inflammatory				
Sjogren's	4	-	-	4
Sialadenitis	2	-	-	-
Abscess	2	2	-	-
Calculus	5	-	-	5
Post RT oedema	1	-	-	-
Extraglandular masses				
Lymph nodes				
TB	7	5	2	2
Reactive	4	4	-	4
Metastases-NPC	5	5	-	-
Lymphoma	11	9	2	11
Misc				
Nerve sheath tumour	1	1	-	1
Haemangioma	1	-	-	1 (RBC scan)
Normal	20	-	-	-
Total	**82**	**43**	**6**	**47**

Table II: Comparison between clinical diagnosis, FNAC and histology for intraglandular lesions

	Clinical diagnosis		FNAC		Histology
Benign mass					
	Benign:	4	Benign:	6	Pleomorph adenoma: 16
	Malignant:	4	Inadequate:	2	Oncocytoma: 1
	?Tumour/node:	7	Pleomorphic adenoma:	8	
	Parotid mass:	2	Oncocytoma:	1	
Malignant mass					
	Malignant mass:	2	Malignant:	2	Mucoepidermoid Ca Adenoidcystic Ca
Sjogren's					
	Sjogrens:	3	- -		Sjogren's: 2
	TB node:	1			Sjogren's + Lymphoma: 2
Sialadenitis					
	Abscess:	1			
	Malignant mass:	1	- -		- -
Abscess					
	Abscess:	2	Abscess:	2	- -
Calculus					
	Calculus:	3	- -		Calculus: 5
	?Tumour/node:	2			
Post RT oedema					
	Malignant mass:	1	- -		- -

Table III: Comparison between clinical diagnosis, FNAC and histology for extraglandular lesions

	Clinical diagnosis		FNAC		Histology
TB nodes					
	Infective node:	4	?TB:	5	
	?Tumour/node:	3	Inadequate:	2	TB: 2
Reactive nodes					
	?Tumour:	2	Reactive:	4	Benign reactive: 4
	?Malignant node:	2			
NPC metastases					
	Malignant node:	3	Malignant:	5	--
	?Tumour/node:	2			
Lymphoma					
	Malignant node:	6	Suspicious:	8	Non-Hodgkins: 7
	Equivocal:	4	Reactive:	1	Benign: 4
			Inadequate:	2	
	?Tumour:	1			
Nerve sheath tumour (NST)					
	?Mass/Node:	1	Benign NST		Benign NST
Haemangioma					
	?Mass/Node:	1	--		Haemangioma

adjacent malignant appearing lymphadenopathy. US and FNAC correctly predicted malignancy in both the patients which was confirmed at surgery. Of the seventeen benign masses there were sixteen pleomorphic adenomas and one oncocytic adenoma. On US all the masses were well defined, homogeneous and twelve showed distal enhancement which is seen as an area of brightness posterior to the tumour. It is seen in tumours which have an homogeneous internal architecture and the ultrasound beam thus encounters few interfaces. No adjacent malignant nodes were seen and calcification was detected in only two cases. US predicted benignity in all the cases, and correctly identified the one case which was of parotid rather than submandibular origin. FNAC predicted eight pleomorphic adenomas and the oncocytic adenoma. Of the remaining eight cases, FNAC correctly predicted benignity in six and two were non-diagnostic aspirates. At surgery all the seventeen masses were confirmed to be benign.

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In Sjogren's syndrome the glands were diffusely enlarged in all four cases. In two cases the glands were heterogeneous with multiple small hypoechoic areas, another showed large cystic spaces throughout the gland and in one the gland showed an unusual lobulated and reticulated appearance which was also seen in the parotid and lacrimal glands. In two of our cases in whom abnormal nodes were detected by US, the patients proceeded to an excision biopsy which confirmed high grade malignant lymphoma.

In two patients with sialadenitis the gland was heterogeneous and diffusely enlarged with no obvious calculus. Both the abscesses were seen as ill-defined cystic areas with irregular outlines and internal debris. Post radiation oedema was seen in one patient; the gland was hypoechoic with a heterogeneous echo pattern.

In the five patients with calculi, intraglandular ductal dilatation was seen in four and an intraglandular abscess in the fifth. In two patients the calculi were intraglandular, and were extraglandular in two. The fifth patient had multiple calculi, intraglandular and extraglandular.

In twenty-seven patients enlarged nodes were detected in the submandibular area (nasopharyngeal carcinoma [NPC] metastases in five patients, seven with tuberculosis [TB], reactive nodes in four and lymphoma in the remaining 11 patients).

In the NPC category, US and FNAC predicted metastatic disease and the probable site of the primary. On US the nodes were well defined, round, hypoechoic and seen in the submandibular area, upper cervical chain and the posterior triangle, common sites for NPC metastases in our experience. Examination of the nasopharynx subsequently revealed the primary tumour. In seven patients US suggested tuberculous lymphadenopathy. The nodes were hypoechoic, ill defined, heterogeneous with necrotic changes within. All of these patients also had similar matted nodes in the posterior triangle. FNAC showed granulomatous changes in five and was non-diagnostic in two patients who then had an excision biopsy which confirmed TB.

US and FNAC correctly predicted benign lymphadenopathy in four cases. All these had excision biopsies to confirm the diagnosis as the patients had a known primary. In eleven patients US suggested the diagnosis of lymphoma. The nodes were hypoechoic, well defined, solid, round and showed distal enhancement in nine patients. FNAC suggested suspicious lymphoproliferative lesions in eight cases and benign reactive adenopathy in one. In two patients FNAC was non-diagnostic. Excision biopsy confirmed non-Hodgkin's lymphoma in seven cases and benign lymphoid hyperplasia in four. All seven patients with non-Hodgkins lymphoma showed distal enhancement, as did two of the four benign hyperplastic nodes.

Although US correctly predicted the haemangioma which was confirmed by a Red Blood Cell (RBC) scan, it was unable to identify the neuroma which was reported as probably a benign node. FNAC suggested the diagnosis of a benign nerve sheath tumour.

Based on histology US had a sensitivity of 97%, specificity 83%, positive predictive value 91% and a negative predictive value of 95%. FNAC had a sensitivity of 100%, specificity 90%, positive predictive value 94% and a negative predictive value of 100%. In 12% of cases (six of 49 cases) the initial FNAC was non-diagnostic.

Discussion

For the detection of salivary calculi, US is the investigation of choice, with a sensitivity of 94%, specificity of 100% and an accuracy of 96%.[5] In addition US accurately localizes the calculus i.e intraglandular or within the main salivary duct, and identifies any abscess formation. All these factors may affect patient management. In our patients with calculus diseases we were able to identify and locate the stone in all five cases (Figure 1), and detect duct dilatation and abscess formation. The surgeon requested no further imaging.

Figure 1: Transverse sonogram of the submandibular gland showing a calculus (arrows) in the main salivary duct with proximal duct dilatation (arrowheads).

In non-calculus disease, we attempted to identify the origin of the lesion i.e from the submandibular gland or outside the gland. Sonography can differentiate intraglandular tumours from extraglandular masses in 98% of cases. [5] In our series we were able to identify the origin of the mass in all the cases.

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Once it was established that the lesion was intraglandular in origin, we classified it as focal or diffuse. For the detection of focal salivary masses sonography has a reported sensitivity and accuracy of 100% as compared to 92% and 87% by palpation.[5] For tumours larger than 1 cm the accuracy of sonography in predicting benignity is 94%.[5] We were able to identify all the focal masses in our series.

Although submandibular gland tumours account for only 10% of all salivary tumours,[6] the incidence for malignancy has been reported to be much higher for submandibular tumours than for parotid tumours (47% vs 25%).[7]

However, in our series only two out of eigthteen (11%) submandibular tumours were malignant. Both the malignant tumours were hypoechoic with ill defined edges (Figure 2), and adjacent adenopathy and FNAC confirmed their malignant nature. In determining benignity/malignancy we found that the tumour edge and the presence of adjacent malignant adenopathy were useful features. With high resolution transducers US is better than CT or MRI in the detection of indistinct borders,[5] cervical lymph node staging can be accurately performed at the same time and if necessary a guided FNAC quickly confirms the nature of the tumour.

The commonest benign submandibular tumours we encountered were pleomorphic adenomas. On US they were well defined, with homogeneous internal echoes and most showed posterior enhancement (Figure 3). Only two of the tumours showed calcification, suggesting a long-standing pleomorphic adenoma which has a higher risk of developing into a carcinoma.[6]

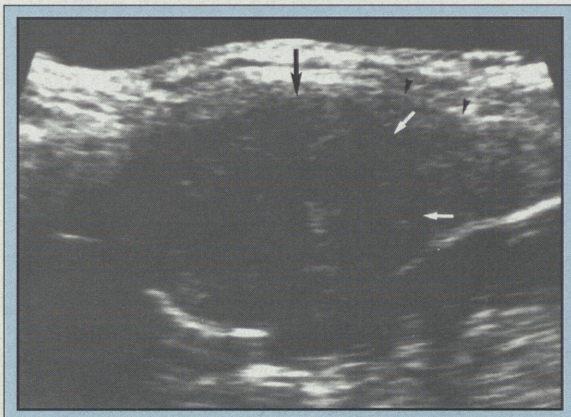

Figure 3: Transverse sonogram of the submandibular gland (arrowheads) showing a solid, hypoechoic well-defined benign tumour (arrows) of the submandibular gland.

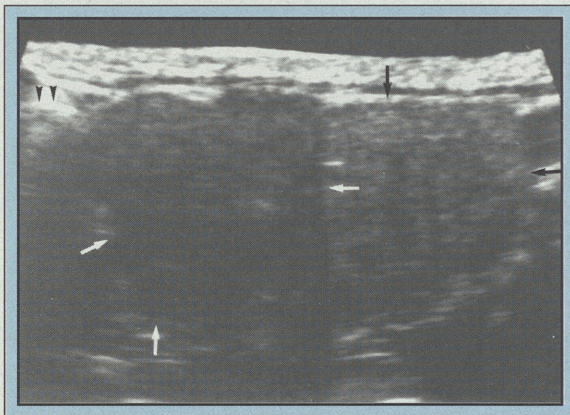

Figure 2: Longitudinal sonogram of the submandibular gland (black arrows) showing a solid, hypoechoic ill-defined malignant tumour (white arrows) of the submandibular gland. Arrowheads identify the mandible.

However no malignant change was seen in either of these cases on FNAC and final histology. The single oncocytic adenoma we saw is more often seen in the parotid gland, is usually solitary and histologically benign. Surgical removal is the treatment of choice.[8] Although on US it does not have any specific features and is indistinguishable from a pleomorphic adenoma, a guided FNAC helped us in making the diagnosis preoperatively which was confirmed following surgery.

In diffuse non-calculus disease of the submandibular gland the role of US is to detect duct dilatation, the presence of a focal abscess and to evaluate the glandular echo pattern. In two of our cases of acute sialadenitis the submandibular gland was diffusely enlarged, hypoechoic, heterogeneous with no evidence of sialectasia or a focal lesion (Figure 4). No FNAC was necessary; only follow-up US scans were performed which showed resolution of the inflammatory process. Another two cases showed abscess formation which was seen as ill defined cystic areas, with irregular outlines and internal debris. A successful guided aspiration yielded pus in both the cases.

Although the diagnosis of Sjogren's syndrome is often made clinically and confirmed by sub-labial minor salivary gland biopsy, US is useful in surveillance of cervical nodes for the detection of lymphoma. In addition the lacrimal glands can also be evaluated by high resolution US. In two of our cases excision biopsy of adjacent abnormal nodes detected by US confirmed high grade malignant lymphoma. In one case a CT sialogram was performed prior to

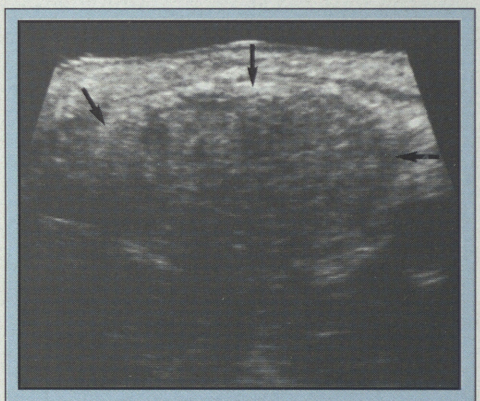

Figure 4: Transverse sonogram showing diffuse inflammatory enlargement of the submandibular gland (arrows) with heterogeneous parenchymal echoes. No obvious calculus or focal abscess detected.

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the US. However we believe that had the US been done earlier, the CT sialogram would not have been necessary.

Post-radiation oedema may also present as a mass in the submandibular triangle. The skin, subcutaneous and soft tissues show a diffuse cobblestone appearance with intervening hypoechoic septae making visualization of the submandibular gland difficult. Follow-up scans after the oedema had subsided show small, hypoechoic irregular atrophic submandibular glands with a coarse echo pattern.

Once we established the salivary glands were normal, the commonest extraglandular lesions in the submandibular triangle in our series were enlarged lymph nodes (Figure 5). In adults the commonest malignancy of the upper aerodigestive tract is squamous cell carcinoma (SCCa). The most important factor that influences

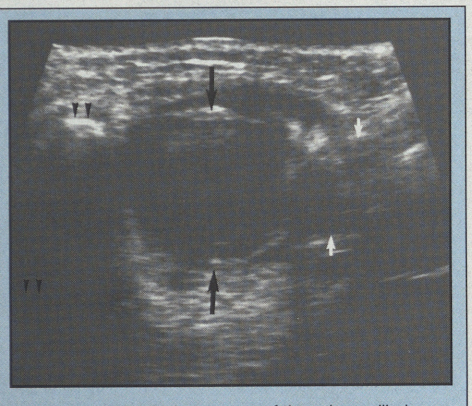

Figure 5: Longitudinal sonogram of the submandibular area showing a malignant node (black arrows) adjacent to the mandible (arrowheads). White arrows identify the visualised portion of the submandibular gland.

therapeutic outcome is the development of metastases to cervical nodes.[9] It is therefore important to identify malignant nodes in the neck. US with its superior sensitivity over clinical examination (92% v 70%), [10] and its specificity when combined with FNAC (92.7%) [11] makes it an ideal initial investigation. US is also sensitive in detecting compression or invasion of the carotid artery and the internal jugular vein prior to surgery.[12]

On US the diagnosis of a haemangioma may be suggested if there is a heterogeneous mass with multiple cystic spaces (Figure 6) with or without

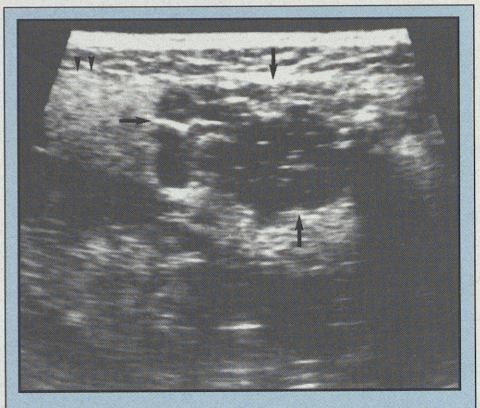

Figure 6: Transverse sonogram of the submandibular area showing an ill-defined, hypoechoic, heterogeneous mass (arrows) with small cystic spaces adjacent to the submandibular gland (arrowheads).

areas of calcification within. A RBC scintigram confirms its nature.[13] However in order to define its entire anatomic distribution and the presence of intraosseus component, a MRI is indicated.

Conclusion

US combined with a guided FNAC answers almost all clinical queries concerning masses in the submandibular triangle and provides the surgeon with relevant information preoperatively. In view of its low cost and easy availability compared to CT and MRI it is an ideal initial investigation. However CT or MRI are still necessary for accurate staging of the primary tumour and determining tumour extent.

References

1. Sakai F, Kiyona L, Sone S, *et al.* Ultrasonic evaluation of cervical metastatic lymphadenopathy. *J Ultrasound Med* 1988; 7: 305-310.
2. Tohnosu N, Onada S, Isono K. Ultrasonographic evaluation of cervical lymph node metastases in esophageal cancer with special reference between the short to long axis ration (S/L) and the cancer content. *J Clin Ultrasound* 1989; **17**: 101-106.
3. Hajek PC, Salomonowitz E, Turk R, Tscholakoff D, Kumpan W, Czembriek H. Lymph nodes of the neck: Evaluation with US. *Radiology* 1986; **158**: 739-742.
4. Bruneton JN, Normand F. Cervical Lymph Nodes. In: Bruneton Jn ed. *Ultrasonography of the Neck*. Springer-Verlag Berlin Heidelberg 1987: 81-92.
5. Gritzmann N. Sonography of the salivary glands. *AJR* 1989; **153**: 161-166.
6. Yasumoto M, Shibuya H, Suzuki S, Ishii J, Amagasa T, Ida M, Okada N. Computed tomography & Ultrasonography in Submandibular Tumours. *Clinical Radiology* 1992; **46**: 114-120.
7. Rabinov K. Salivary Glands-Pathology. In Taveras JM, ed. *Radiology*, **Vol 3**. Philadelphia: J.B. Lippincott, 1986; 95: 1-8.
8. Som PM. Salivary Glands. In: Som PM & Bergeron RT eds. *Head & Neck Imaging, 2nd edition*. Mosby Year Book Inc, 1991: 277-348.
9. Johnson JT. A surgeon looks at cervical lymph nodes. *Radiology* 1990; **175**: 607-610.
10. Bruneton JN, Roux P, Caramella E, Demard F, Vallicioni J, Chauvel P. Ear, Nose, and Throat Cancer: Ultrasound diagnosis of metastasis to cervical nodes. *Radiology* 1984; **152**: 771-773.
11. Baatenberg de Jong RJ, Rongen RJ, De Jong PC et al. Metastatic Neck Disease. Palpation vs Ultrasound Examination. *Arch Otolaryngol Head Neck Surg* 1989; **115**: 689-690.
12. Gritzmann N, Grasl M Ch, Helmer M, Steiner E. Invasion of the Carotid Artery & Jugular Vein by Lymph Node Metastases: Detection with Sonography. *AJR* 1990; **154**: 411-414.
13. Bradley M, Stewart I, Metreweli C. The role of ultrasound and ^{99m}Tc RBC Scintigraphy in the diagnosis of salivary gland haemangioma. *Br J of Oral & Maxillofacial Surgery* 1991; **29**: 164-165.