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THE ROLE OF ULTRASOUND IN EVALUATING SALIVARY GLANDS SWELLINGS

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ABSTRACT

BACKGROUND:

Salivary gland swelling presents a variety of neoplastic and non-neoplastic conditions. Predicting the nature of swelling on clinical grounds alone is rarely possible hence, further assessment with accurate imaging is a necessity. Ultrasonography is a diagnostic tool that is widely available, relatively inexpensive, non-invasive, and easily reproducible. Viral infection is the most common cause of salivary gland swelling as mumps which mainly affects the parotid glands. Sialolithiasis is another cause of obstruction of the salivary duct.

MATERIAL AND METHOD:

a cross-sectional study has been conducted in the Department of Radiology. The subjects were selected from regular out / in patients visiting the Department of Radiology, Hospital for ultrasonographic evaluation of clinically suspected salivary gland lesions. All patients who were referred for USG evaluation of clinically suspected salivary gland swelling were included.

RESULTS:

A total of 70 patients with salivary gland swelling were included in our research that were divided into two groups. Group 1 included patients with parotid gland swellings 35 patients. Group 2 included patients with submandibular gland swellings 35 patients. Most of our patients were females representing 57% of the study group. Submandibular gland lesions presented with sialolithiasis 35 cases, 19 cases of parotid gland swellings presented as inflammation without stone 12 cases of acute inflammation and 4 cases with recurrent inflammation, while 4 patients only presented as sialolithiasis. Neoplastic lesions were diagnosed in 12 cases of the parotid gland group.

CONCLUSION:

Ultrasound is the investigation of choice in salivary gland swellings. Computed tomography could be needed in certain cases such as deep parotid gland lesions or sialolithiasis with small stones in the ducts of the salivary glands. Computed tomography should be done in cases suspected of malignant salivary gland lesions. Ultrasonography showed significantly high sensitivity and specificity in diagnosing non-neoplastic lesions and thus, ultrasonography evaluation of salivary gland lesions helps in the decision-making of surgical intervention.

KEYWORDS: Parotid, Submandibular Gland, Ultrasonography, Salivary Glands and Salivary Tumor.

INTRODUCTION

Salivary glands are important structures that secrete saliva, that take part in the food digestion process. In addition to saliva carrying some digestive enzymes, it also takes part in the body's defense system through its concentration of antibodies. The accumulation of bacteria on intra-oral structures is prevented by the constant flow of saliva in the mouth which in turn reduces the chances of infection. Speech and mastication are made easy and comfortable through the lubrication effect of saliva. However, salivary glands often develop diseases and conditions that can affect their basic functions. Metabolic disorders, infections (fungal, bacterial, and viral), neoplastic conditions (both benign and malignant), cysts and occasionally trauma can affect the function of single or several glands. Such conditions often cause discomfort or pain resulting in physical and psychological incapacitation. Salivary gland diseases rarely present with any symptoms during the early stages except for acute infections which are usually painful.[1] Mumps is one of the viral infections of the salivary gland and the most common cause of salivary gland swellings. Sialolithiasis is one of the causes of bacterial infection affecting the salivary

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gland clinically presented as enlarged and tender lymph nodes of the neck and pus formation of the infected salivary gland. A tumor is another cause of the swelling. Around 70% of salivary gland tumors arise from the parotid glands. Benign lesions represent 57% of these tumors. Three to 5% of all tumors affecting the head and neck are represented in salivary gland tumors.[2] Ultrasound is the initial imaging method for salivary gland swellings. The deep lobe of the parotid is difficult to be examined using ultrasound (U/S). U/S has higher accuracy in delineating benign and malignant salivary gland tumors.[3]

Ultrasound evaluation is quick and non-invasive. Ultrasonography can differentiate possible benign from malignant neoplasms.[4] It can demonstrate features of inflammation or abscess formation. USG can differentiate whether a palpable lesion over the salivary gland region arises within the salivary gland or is peri glandular in location. USG is helpful in differentiating cystic from solid lesions; aids in guiding the exact site of Fine Needle Aspiration Cytology (FNAC) in suspected salivary gland lesions.[5] When combined with color Doppler imaging, it helps in assessing the vascularity and nature of the lesion (malignant lesions of salivary glands are highly vascular as compared to their benign counterparts). RI and PI values of greater than 0.7 and 1.2, respectively, coupled with high PSV (greater than 44.3 cm / s), ill-defined margins, and nodal involvement with central vascularity are highly indicative of malignant salivary gland lesions.[6] USG helps in differentiating intra-parotid lymph nodes from true intra-parenchymal lesions, identifying calcifications / diffuse lesions, and detecting major ductal dilatation with intraductal calculi.[7] In general, CT is considered the best single method for the assessment of inflammatory diseases, and MR imaging is considered the best single method for the assessment of salivary gland tumors.[8,9], In fact, the US with US-guided fine needle aspiration cytology (FNAC) of the lesions examination alone may suggest the final diagnosis in most clinical settings. As the head and neck region has a complex anatomic structure, a sound knowledge of sonographic anatomy and spatial relationships is crucial for the reliable performance of the examination.[10] Detection of salivary gland stones by computed tomography depends on whether calcium exists or not in the calculi. Magnetic resonance imaging is a non-irradiating alternative imaging modality for the assessment of ductal pathologies without the risk of radiation or cannulation of the duct, but magnetic resonance sialography is much more expensive and not available in most healthcare units. It showed sensitivities and specificities of 80–100% and 90–100% in the detection of sialolithiasis.[11] Our study is to evaluate the role of ultrasound in the evaluation of salivary gland swellings in comparison with a computed tomography scan.

MATERIAL AND METHODS

a cross-sectional study has been conducted in the Department of Radiology. The subjects were selected from regular out / in patients visiting the Department of Radiology, Hospital for ultrasonographic evaluation of clinically suspected salivary gland lesions. All patients who were referred for USG evaluation of clinically suspected salivary gland swelling were included. Those who were unwilling to give valid consent for the study, patients who had undergone surgery for the same lesion previously, and those patients who were not followed up in our hospital were excluded. After getting valid consent from the study subjects, detailed history was taken, and clinical examination findings and clinical diagnosis were filled in the proforma. The patients were then subjected to ultrasonographic examination. Informed written consent was taken from the patients or their guardians willing to participate in the study. A total of 70 patients with salivary gland swelling were included in our research which was divided into two groups. Group 1 included patients with parotid gland swellings (35 patients). Group 2 included patients with submandibular gland swellings (35 patients). All patients underwent ultrasonography and computed tomography examination of the neck. Ultrasound examination of the neck was performed including examination of both parotids and submandibular glands with emphasis on the site of the swelling. Patients were examined in the supine position with a mild tilt of the head upwards when examining the submandibular glands and to the contralateral side when examining the parotid gland

Ultrasonographic examinations

Ultrasonographic examinations were performed by an experienced radiologist using the superficial linear probe of a high-quality ultrasound machine with a frequency of 7–14 MHz depending on the site examined. Each salivary gland was evaluated in at least two perpendicular planes for its size, echogenicity, and presence of stones or masses. Then, the whole neck was scanned to assess the lymph nodes and search for concomitant or related diseases.

Multi-detector computed tomography examination

Multi-detector computed tomography examination of the neck was performed for all patients with or without contrast according to the suspected pathology. Patients were examined in the supine position with the scan covering from the base of the skull to the aortic arch. Intravenous iodinated contrast media was used in cases suspected of neoplasm in a dose of 1 ml/kg with a maximum of 70 ml with an injection rate of 2 mm/s. Axial volume was taken with a thickness of 2.5 mm and then transferred to a workstation where multi-planar reconstruction was performed to obtain coronal and sagittal images of the glands. Each gland was assessed for stones or masses and compared to the ultrasound findings.

The USG findings were entered into the proforma and the ultrasonographic diagnosis was reached. The patients were then subjected to histopathological examination for confirmation of diagnosis which is considered the gold standard. For the confirmatory diagnosis of acute sialadenitis and salivary gland abscess, clinical follow-up (response to medical treatment) and findings on incision & drainage was taken as diagnostic gold standard respectively

STATISTICAL ANALYSIS

All statistical analyses were performed at a 5% confidence interval, and a p-value < 0.05 was considered significant. The statistical software package Statistical Package of the Social Sciences 15.0 (SPSS Inc., Chicago, IL, USA) was used for the analysis of the data. In addition to the standard descriptive statistical calculations as mean and standard deviation (SD), the results on categorical measurements were presented in numbers (%).

RESULT: -

Table 1: shows the Patient's characteristics

Patient data		No. (%)
Age	Mean ± standard deviation = 33.2 ± 10.2	
Sex	Male	30 (40%)
	Female	40 (60%)

A total of 70 patients with salivary gland swelling were included in our research that were divided into two groups. Group 1 included patients with parotid gland swellings 35 patients. Group 2 included patients with submandibular gland swellings 35 patients. Most of our patients were females representing 60% of the study group. Their epidemiological characteristics are grouped in Table 1

Table 2: The nature of salivary gland swellings

The nature of salivary gland swellings	No. of cases = 70	
	Parotid group	Submandibular group
Sialolithiasis	4	35
Inflammation without stone	19	–
Neoplasm	12	–

Table 2 shows all submandibular gland lesions presented with sialolithiasis 35 cases, 19 cases of parotid gland swellings presented as inflammation without stone 12 cases of acute inflammation and 4 cases with recurrent inflammation), while 4 patients only presented as sialolithiasis. Neoplastic lesions were diagnosed in 12 cases of the parotid gland group. In all 4 cases of acute sialadenitis, the salivary glands were diffusely enlarged. All of the cases showed increased internal vascularity and enlarged regional lymph nodes.

Table 3: Radiological findings in cases diagnosed as neoplasm

parotid group	No. of cases 14	
Findings	U/S CT	CT
Well-defined	12	12
Ill-defined	2	2
Enlarged lymph nodes	2	2
Invasion to surroundings	–	1

Table 3 shows 14 parotid swellings diagnosed with neoplastic lesions that appeared as hypoechoic masses in the ultrasound and hypodense masses in the computed tomography (CT), and 12 parotid cases showed well-defined margins by CT and U/S. Enlarged lymph nodes appeared in only 2 cases by either CT or U/S, but only one case showed invasion to the surrounding that was not detected by the U/S.

DISCUSSION

The imaging diagnosis of salivary gland tumors is still a matter of controversy either by ultrasonography or computed tomography. Tumors with a diameter of less than 1 cm and isodense masses can escape from the diagnostic tools. As well as small salivary gland stones cannot be obvious by available imaging studies.[3]

Dost et al.1997[12] calculated the normal size of major salivary glands in European and Asian patients and published similar but not exactly equal results concerning anterior-posterior (PG 36–37 mm, SMG 34–35 mm), coronal section/depth (PG 17–23 mm, SMG 14–17 mm), and transversal section (PG 43–46 mm, SMG 23–33 mm). The shear wave velocity (SWV) in the elastography in normal glands was measured to be 1.99 m/s for the PG and 2.32 m/s for the SMG. Patients presenting with enlarged glands may also have glands that appear normal. The differentiation of constitutional variations and sialadenosis from non-pathological glands can be difficult. The glands (PGs and much more than SMGs) are massively enlarged, seem to have no clearly defined borders of the gland tissue to the deeper tissue layers, and do not show any signs of obstruction

Lustmann J et al.1990[13] studied 245 patients with sialolithiasis, treated during a period of 20 years. They found that the submandibular gland was involved in 231 patients, the parotid gland in 11 patients, and the sublingual gland only in 1 patient. Among neoplastic lesions, benign neoplasms were more common in which pleomorphic adenoma was the commonest tumor and among inflammatory conditions, sialadenitis was the commonest lesion. The most commonly encountered lesion among the malignant tumors was mucoepidermoid carcinoma.

Li LJ et al.2008[14] studied 3461 cases of salivary gland tumors retrospectively between the years 1955- 2002 and they concluded that primary tumors mostly occur in the parotid, and pleomorphic adenoma was the most common benign tumor followed by Warthin's tumor. The most common malignant tumor was mucoepidermoid followed by adenoid cystic carcinoma. In this study, all cases of acute sialadenitis showed diffusely enlarged salivary glands. Echo pattern was hypoechoic in the majority of cases and the rest showed heterogeneous echotexture.

Terraz et al.2013[2] made a study on 53 calculi diagnosed in 44 salivary glands (11 parotid glands and 33 submandibular glands). The majority of the cases (57%) showed salivary gland stones greater than 3 mm. Twenty-three percent of the studied cases showed stones with a diameter of less than 3 mm in ten glands, and 20% of these cases showed stones with a diameter of 3 mm in nine glands. Therefore, whenever a stone was detected by ultrasound, it was considered true-positive for sialolithiasis.

Gritzmann 1989[15] reported 94% sensitivity of ultrasound of the major salivary glands, but the size of the calculi was not reported with sonography, while **Diederich et al. 1987**[16] reported only 71% sensitivity. **Jager et al. 2000**[17] reported 80% sensitivity in 20 patients with suspected submandibular gland sialolithiasis. About 3% of head and neck tumors arise from the salivary gland, which remains asymptomatic until growing to a great size or invading neighboring structures, such as the muscles, nerves, or ducts, where they are superficially located and easy to be detected. It is difficult to identify certain lesions such as deep-located tumors or tumors. Some imaging modalities such as U/S, CT, and magnetic resonance imaging (MRI) are necessary for clinical diagnosis.[18]

Rudack et al.2007[19] showed that the chi-square test showed no significant difference between computed tomography, ultrasound, and MRI. The diagnosis could be the same using different salivary gland imaging techniques when done for the benign salivary gland lesions while in malignant lesions, CT should be used to assess the invasion of the surrounding structures.

Sriskandan N et al.2010[20] evaluated 220 patients who presented with palpable parotid lesions over a period of 11 years and they found that 201 patients had focal lesions: 29 carcinomas, 21 lymphomata, and 151 benign lesions (including 69 pleomorphic adenomas and 54 Warthin's tumors); 19 patients did not have focal lesions. Out of 201 focal lesions, 25 were indeterminate in the initial ultrasound report. The sensitivity, specificity, and diagnostic accuracy for malignancy were 91 %, 93 %, and 93 %, respectively in the remaining 176 lesions. **Kamble RC et al.2013**[21] in their study found that ultrasonography is a valuable and useful method for the diagnosis of salivary gland diseases. From

the study, it is clear that there was 100 % congruency between the final diagnosis and ultrasonographic diagnosis in all the cases of non-neoplastic lesions. For benign and malignant neoplasms, a congruency of 81 % and 83 % were noted respectively

Computed tomography in the study offered by Kinoshita et al.2004[22] showed 45% of cases with the right diagnosis. In malignant lesions, ultrasound could forecast the correct diagnosis in 4 of 30 cases (13%). Ultrasound showed 54% specificity in benign salivary gland lesions, whereas malignant salivary gland tumors could need multiple imaging techniques to reach the right diagnosis.

CONCLUSION:

Ultrasound is the investigation of choice in salivary gland swellings. Computed tomography could be needed in certain cases such as deep parotid gland lesions or sialolithiasis with small stones in the ducts of the salivary glands. Computed tomography should be done in cases suspected of malignant salivary gland lesions. Ultrasonography showed significantly high sensitivity and specificity in diagnosing non-neoplastic lesions and thus, ultrasonography evaluation of salivary gland lesions helps in the decision-making of surgical intervention. Therefore, ultrasonography is a valuable supplement in the diagnosis of salivary gland lesions and to distinguish neoplastic/non-neoplastic lesions so that further management can be decided accordingly.

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