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Diagnostic validity of Ultrasonography in Salivary gland pathologies – A Descriptive study

[1]Geethu R G, Senior Resident, Dept. of Oral Medicine and Radiology, Government Dental College, Thiruvananthapuram, Kerala, India.

[2]Girija K L, Associate Professor, Dept. of Oral Medicine and Radiology, Government Dental College, Thiruvananthapuram, Kerala, India.

[3]Tinky Bose C, Professor and Head, Dept. of Oral Medicine and Radiology, Government Dental College, Thiruvananthapuram, Kerala, India.

[4]Abhirami P T, Senior Resident, Dept. of Oral Medicine and Radiology, Government Dental College, Thiruvananthapuram, Kerala, India.

Corresponding Author: Geethu R G, Senior Resident, Dept. of Oral Medicine and Radiology, Government Dental College, Thiruvananthapuram, Kerala, India.

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Abstract

Aim: To evaluate the diagnostic validity of ultrasonography in salivary gland swellings.

Methodology: A descriptive study was conducted in patients with salivary gland pathologies indicated for ultrasound examination, reporting to Oral Medicine and Radiology department, Government Dental College Thiruvananthapuram for a period of one year from January 2018 to December 2018. All patients were examined clinically and ultrasonographically. Findings were recorded in a structured predesigned proforma. Histopathology was considered as confirmatory. Descriptive analysis and diagnostic test evaluation was done. Diagnostic validity of ultrasonographic diagnosis of patients with salivary gland pathologies against histopathology was expressed using diagnostic performance indicators like Sensitivity, Specificity, Positive predictive value, Negative predictive value and Accuracy. Inter observer variability was assessed using Kappa statistics.

Results: 110 patients were included in the study. 52.7% were females and 47.3% were males with a mean age of 39 years. Sonographic criteria of each type of swelling were described. Diagnostic test evaluation for ultrasonography shows 100 % sensitivity, specificity, positive predictive value, negative predictive value and accuracy for diagnosis of ranula, sialadenitis, and Sjogren'syndrome.

Conclusion: The results of present study strengthen the usefulness of ultrasound imaging in the diagnosis and screening of salivary gland pathologies.

Keywords: Diagnostic validity; Salivary gland pathologies; Ultrasonography

Introduction

A variety of disease processes affect the salivary glands including inflammatory, systemic, obstructive and neoplastic. Many of these salivary gland diseases are rare and the investigative methods available are also minimal and less productive. Although diverse, most of the salivary gland disorders manifest themselves as the enlargement of the gland[1]. In day-to-day practice imaging plays a very important role in the diagnosis and treatment planning for various head and neck pathologies, which often present a diagnostic dilemma. Among all the imaging modalities used today, ultrasound has emerged as popular modality because it is non-invasive and cost effective.[2] Compared to other prominent methods of medical imaging, USG has several advantages: it provides images in real time, is portable, inexpensive, radiation free, non-invasive, and unaffected by metal artefacts, such as dental restorations. It also allows identification of the vascularity of lesions via its Power Doppler and Colour Doppler facilities and is capable of differentiating cystic from solid lesions; it is also helpful in differentiating benign from malignant masses.[3]

Materials and methods

The study was conducted in the Department of Oral Medicine and Radiology, Govt Dental College, Trivandrum from January 2018 to December 2018. The group under study was comprised of 110 patients of all age groups attending the department with signs and symptoms related to salivary gland diseases. All cases indicated for ultrasound examination were evaluated clinically after taking proper informed consent. Ultrasonographic evaluation was performed following a systematic scanning protocol.

All the ultrasound examinations were performed with high resolution real time LOGIQUE C5 ultrasound scanner with 7-12MHz transducers. Ultrasound findings were documented with special reference to shape, size, border, internal architecture, vascularity, echogenicity etc. Colour Doppler facility was used for relevant cases. Data obtained were transferred on the proforma for evaluation and statistical study.

The following sonographic parameters were studied in each case.

- Size of salivary gland.
- Echogenicity of salivary gland.
- Echotexture of salivary gland.
- Vascularity of salivary gland.
- Ductal system of salivary gland.
- Bilateral cervical region for evidence of cervical lymphadenopathy.

All the patients with suspected salivary gland disease underwent FNAC examination except those presented with acute inflammation of gland and in the latter cases, histopathology was considered confirmatory. Data entry was done using SPSS 16 for Windows. Descriptive analysis and Diagnostic test evaluation were done for the data recorded. Diagnostic validity of ultrasonographic diagnosis of patients with salivary gland pathologies against histopathology was expressed using diagnostic performance indicators like Sensitivity, Specificity, Positive predictive value, Negative predictive value and Accuracy.

Results

Of the 110 cases predominating age group was 30-49 yrs (39.1%) with a mean age 39 ± 17.6 yrs and age range of 7-71 years. 52.7% (58) were females and 47.3% (52)

were males which shows a slight female predominance. The percentage distribution of the sample according to ultrasonographic diagnosis [Fig 1] showed 42 % were cystic lesions, 36% were inflammatory pathologies including sialadenitis and sialolithiasis, 10% were Sjogren's syndrome, 13% were benign salivary gland neoplasm and 4% were malignant salivary gland neoplasm. The histopathologic diagnosis was considered to be confirmatory [Fig 2]. For all patients a second observer also examined the sonograms and the observations were recorded. The interobserver variability was assessed using kappa statistics and a kappa value of 0.83 was obtained which showed an excellent inter observer agreement.

Ultrasonographic features of various salivary gland pathologies

The cystic lesions were found to be predominantly oval, well defined and homogenously anechoic with posterior wall acoustic enhancement. Majority of the lesions were less than 2 cm in size.

The lesions of sialadenitis show poorly defined borders, heterogenous with predominantly hypoechoic pattern, multiple hypoechoic foci and increased vascularity. Sialoliths appeared as linear well-defined hyperechoic patterns with posterior wall acoustic shadowing.

Benign salivary gland neoplasms showed well defined boundaries with homo geneously hypoechoic pattern with size less than 2 cm in 65% cases with no increased vascularity in all cases. Out of the 13 benign salivary gland pathologies 8 were pleomorphic adenomas and most of the pleomorphic adenoma cases appeared lobular in shape with posterior wall acoustic enhancement. Malignant salivary gland neoplasm appeared with irregular margins, infiltrating/ poorly defined boundary, heterogenous with predominantly hypoechoic pattern, with multiple hypoechoic internal foci and all the lesions characteristically shows increased vascularity. In two of the malignant neoplasms, malignant lymph nodes were noted.

Ultrasonographic features of Sjogren's syndrome showed decreased size of the glands with heterogenous glandular parenchyma in all cases. The gland appeared hypoechoic, the internal foci within the gland were multiple echogenic focus and echogenic lines.

Diagnostic validity of ultrasonography [Table 1]

There was 100% sensitivity, specificity, positive predictive value, negative predictive value and accuracy for ultrasonography in cases of ranula, sialadenitis and Sjogren's syndrome. The least sensitivity was for malignant salivary gland neoplasm (80%), but it has got 100% specificity.

Discussion

In the present study out of the 110 cases predominating age group was 30-49 (39.1%) with a mean age of 39 years and a standard deviation of 17.6 with the youngest aged 7 years and oldest aged 71 years. There was a slight female predominance in the present study which was in consistent with the study done by T.Sridhar and N. Gnana Sundaram. [4]

In a study done by Bradley M J and Ahuja,[5] cystic lesions were found to be predominantly round/oval in shape, with homogenously anechoic without internal foci. This was in concurrence with the present study where the cystic lesions [Fig 3] were oval in shape (74%) with well-defined boundaries in 100% cases and homo geneously anechoic. Posterior wall acoustic enhancement was present in 95% cases which was characteristic of cystic lesions. Two of the cases which was diagnosed clinically as mucocele, ultrasonographic ally appeared as hypoechoic areas with increased vascularity in Colour Doppler and was diagnosed

ultrasonographic ally and histopathologic ally as vascular lesion.

In Bialek et al[6] study, in ultrasonographic examination of sialadenitis, the salivary glands were enlarged and hypoechoic, inhomogeneous with multiple, small, hypoechoic areas and may have increased blood flow at Colour Doppler. In the present study also the gland appeared to be enlarged with poorly defined boundaries (80%), heterogenous with multiple hypoechoic internal foci[Fig 4]. Vascularity within the gland was increased in 90% of cases. Some clinically diagnosed cases of sialadenitis was diagnosed ultra sono graphic ally as sialolithiasis because of the well differentiated appearance of sialoliths in the ultrasound examination.

The ultrasonographic observations of sialolith in a study done by T.Sridhar et al[4]

showed isoechoic gland, homogenous internal echoes, posterior shadowing, irregular stone and intraductal calcification with dilated ducts. This was also similar in the present study; the sialolith appeared to be well defined linear/elliptical structures which were homogenously hyperechoic or predominantly hyperechoic with characteristic posterior wall acoustic shadowing [Fig 5]. Two cases of sialolithiasis misdiagnosed ultra sono graphic ally as benign lymphadenopathy in our study because of the normal architecture of the glandular parenchyma, less size of the sialolith that cannot be appreciated in ultrasound examination and the presence of multiple lymph nodes.

Patients with recurrent fever, salivary gland inflammation, arthralgia and immunological test positive for antinuclear antibodies, rheumatoid factor, anti – SSA and anti- SSB with suspected Sjogren's syndrome were included in the study for the ultrasonographic evaluation of the salivary glands. All the patients with suspected Sjogren's syndrome showed decreased size of the glands with heterogenous glandular parenchyma. The internal foci within the gland were multiple echogenic focus and echogenic lines. Based on the clinical, serological and ultrasonographic findings, diagnosis of Sjogren's syndrome was made and it very well established with histopathological diagnosis. Sjogren's syndrome showed a slight female predilection. The ultrasonographic findings were in conjunction with the study done by Guissa VR et al.[7] Although ultrasound was not validated as a diagnostic criterion for Sjogren's syndrome the patients evaluated in this study showed clinical and immunological characteristics suggestive of the syndrome exhibited ultrasonographic patterns supporting the diagnosis of the disease.

According to a study done by Renehan A et al[8], pleomorphic adenoma occurs most often in the parotid gland (60% – 90%) mostly in fourth and fifth decades of life with a slight female predominance. The ultrasonographic images of pleomorphic adenomas shows hypoechoic, well defined, lobulated tumours with posterior acoustic enhancement and may contain calcifications.[9] Out of the 12 benign salivary gland neoplasm encountered in the present study, 66% were pleomorphic adenoma and was found to more frequent in the parotid gland with a slight male predominance. Most of the pleomorphic adenomas in this study appeared sonographic ally as lobular/cyclic or ovular [Fig 6] in shape with well-defined borders, hypoechoic, heterogenous with multiple hypoechoic/ single echogenic foci with posterior wall acoustic enhancement noted in three cases and these findings were similar to the studies mentioned.

Three cases of benign salivary gland neoplasm in this study were Warthin's tumour which ultrasonographic ally appeared as well-defined oval/round, homogenously hypoechoic with multiple anechoic internal foci **[Fig 7]**.

According to Bialek *et al*[6], Warthin's tumours were oval hypoechoic well-defined tumours with multiple anechoic areas, which was in consistent with this study, and most often arises in men in fifth and sixth decades of life and were often hyper vascularised. In our study all the lesions of Warthin's tumour appeared avascular and were found to be more prevalent in males and age greater than 65 years.

According to Bradley M J and Ahuja[5], ultrasound features of malignant salivary gland neoplasms include an irregular shape, irregular borders, blurred margins and hypoechoic inhomogeneous structure. Shick et al[10] and Bradley conclude that high vascularisation should raise the suspicion of malignancy.In the present study, out of the five malignant salivary gland neoplasm, only one was diagnosed clinically, and one was misdiagnosed ultrasonographic ally as benign salivary gland neoplasm. Four of the malignant salivary gland lesions in this study were mucoepidermoid carcinoma; appeared sonographic ally with irregular margins, infiltrating/ poorly defined boundary, heterogenous with predominantly hypoechoic pattern, with multiple hypoechoic internal foci and all the lesions characteristically showed increased vascularity [Fig 8] and were in concurrent with the study done by Bialek et al[6]. In two of the malignant neoplasms, malignant lymph nodes were noted.

One of the malignant neoplasms in our study was adenoid cystic carcinoma of submandibular gland which was misdiagnosed ultrasonographic ally as benign salivary gland neoplasm due to the lobulated shape, well differentiated borders and homogenous echo structure. Hardees PS et al[11] in 2001 also demonstrated that malignant tumors may be homogenous and well defined and may have a lobulated shape.

According to Patange et al[12], on Colour Doppler the benign lesions showed peripheral vascularity, inflammatory lesions had diffuse marked vascularity in the gland and malignant lesions showed central vascularity. In this study also, it was very well able to differentiate benign, inflammatory and malignant conditions of the salivary gland based on Colour Doppler.

Contingency table [Table 2] was constructed for ultrasonographic vs. histopathologic diagnosis and contingency coefficient values of 0.927 and a significant p value ($p<0.01$) was obtained showing significant association of ultrasonographic diagnosis with histopathologic diagnosis.

Performance indicators like sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of ultrasonographic evaluation were calculated. The present study got 100 % sensitivity, specificity, positive predictive value, negative predictive value and accuracy for Ranula, Sialadenitis and Sjogrens syndrome. For mucocele there is 96.3% sensitivity, 98.8% specificity and 98.2 % accuracy. In a study done in 2012, the ultrasound sensitivity in detecting cystic lesions was 92.3%.[13]In the present study, the sensitivity and specificity for sialolithiasis detection was 92.9% and 100 % respectively.

In the study done by Cecilia Petrov anet al,[14] the sensitivity in determining benign salivary gland neoplasm was 83% and that for malignant salivary gland neoplasm was 75.5% and a positive predictive value of 84.2% and negative predictive value of 71.4% in detecting tumoral lesions. As compared to this, the present study has got a much higher sensitivity – 96.3% and 80% for benign and malignant salivary gland neoplasms respectively. The positive predictive value of detecting benign neoplasms found to be 84.6% which was almost similar to the study done by Cecilia Petrov anet al.

Conclusion

The present study has concluded that high resolution ultrasound examination along with Colour Doppler should be used as first line imaging modality in evaluation of salivary gland disease.

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List of table and figures

Table 1: Diagnostic validity of ultrasonography

Criteria	Mucocele	Ranula	Siala-denitis	Sialoli-thiasis	Siala-denosis	Sjogrens syndrome	Benign salivary gland neoplasm	Malignant salivary gland neoplasm	Others
Sensitivity	96.3	100.0	100.0	92.9	0.0	100.0	91.7	80.0	100.0
Specificity	98.8	100.0	100.0	100.0	100.0	100.0	98.0	100.0	97.2
False	3.7	0.0	0.0	7.1	100.0	0.0	8.3	20.0	0.0

Negative									
False positive	1.2	0.0	0.0	0.0	0.0	0.0	2.0	0.0	2.8
Positive Predictive value	96.3	100.0	100.0	100.0	0.0	100.0	84.6	100.0	40.0
Negative Predictive value	98.8	100.0	100.0	97.6	99.1	100.0	99.0	99.1	100.0
Positive Likelihood ratio	79.93	-	-	-	-	-	44.92	-	36.00
Negative Likelihood ratio	0.04	0.00	0.00	0.07	1.00	0.00	0.09	0.20	0.00
Accuracy	98.2	100.0	100.0	98.2	99.1	100.0	97.3	99.1	97.3

Table 2: Ultrasonographic diagnosis vs histopathological diagnosis – Contingency table

Ultrasonographic diagnosis	Histopathology diagnosis									
	Mucocele	Ranula	Siala-denitis	Sialoli-thiasis	Siala-denosis	Sjogrens syndrome	Benign salivary gland neoplasm	Malignant salivary gland neoplasm	Others	Total
Mucocele	26						1			27
Ranula		15								15
Sialadenitis			10							10
Sialolithiasis				26						26
Sialadenosis										
Sjogrens syndrome						10				10
Benign salivary gland neoplasm	1						11	1		13
Malignant salivary gland neoplasm								4		4
Others				2	1				2	5
Total	27	15	10	28	1	10	12	5	2	110

Figures

Fig 1: Percentage distribution of sample according to Ultrasonographic diagnosis

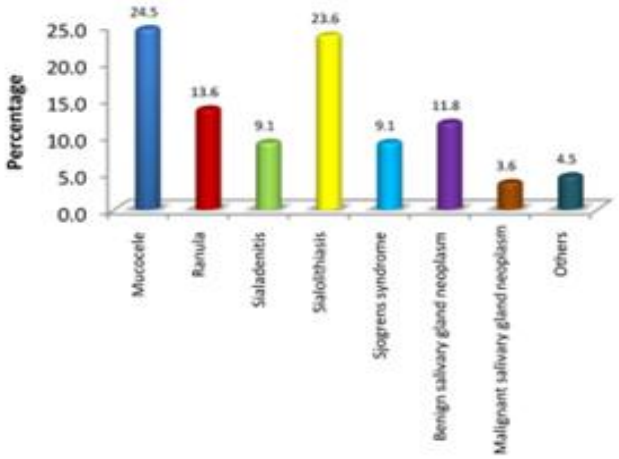

Fig 2: Percentage distribution of sample according to histopathologic diagnosis

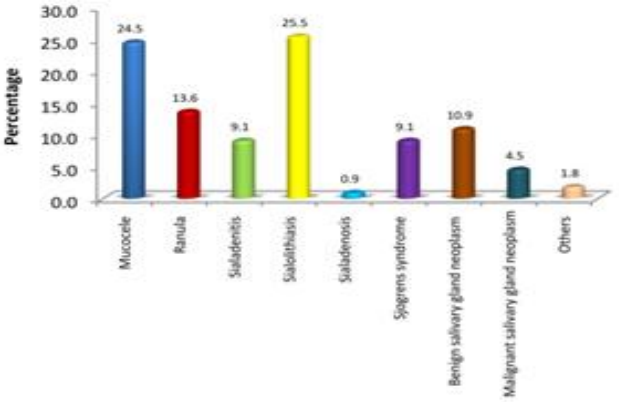

Fig 3: Ultrasonographic image of ranula

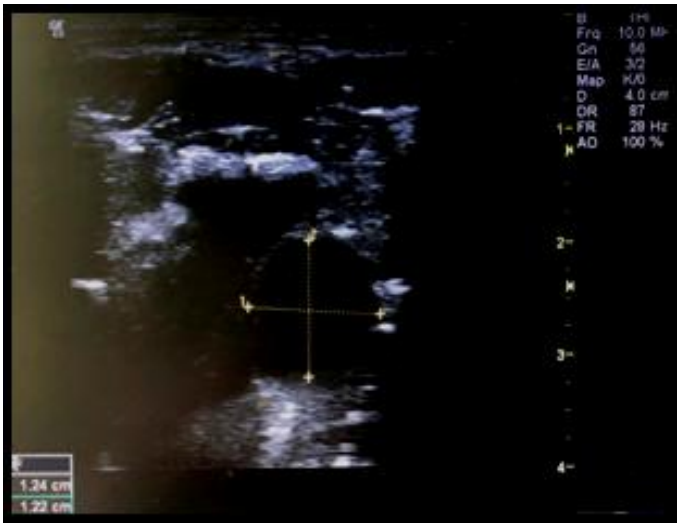

Fig 4: Sialadenitis of parotid gland with abscess collection

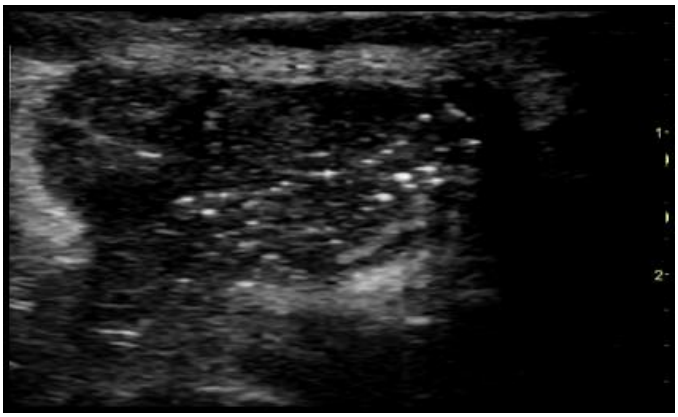

Fig 5: Sialolithiasis of submandibular gland

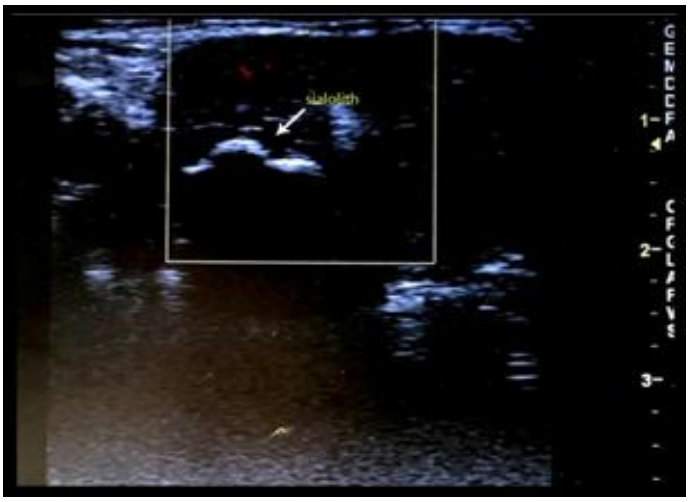

Fig 6: Ultrasonographic image of pleomorhic adenoma with polycyclic pattern

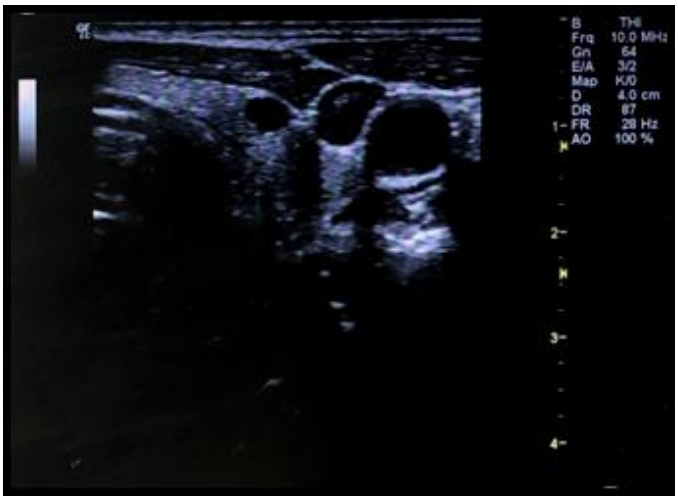

Fig 7: Ultrasonographic image of Warthins tumor

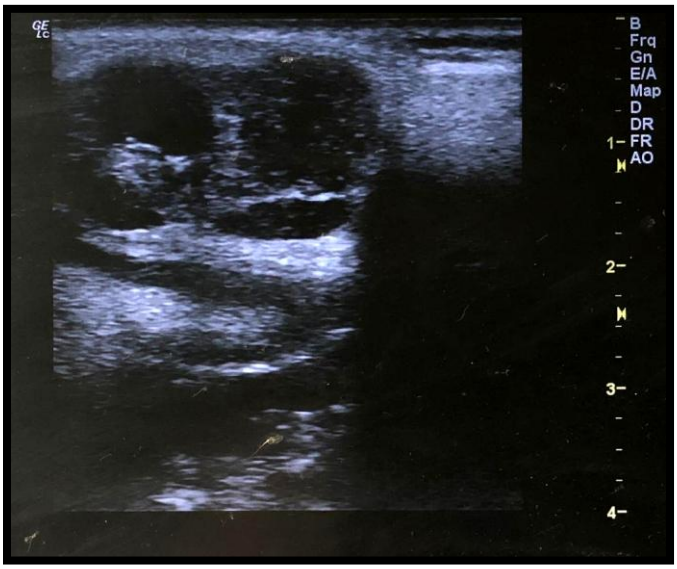

Fig 8: Ultrasonographic image of malignant salivary gland neoplasm