(International Print/Online Journal)

SJIF IMPACT FACTOR: 5.565
PUBMED-National Library of Medicine ID-101739732

ISSN (Print): 2209-2870
ISSN (Online): 2209-2862

International Journal of Medical Science and Current Research (IJMSCR)
Available online at: www.ijmscr.com
Volume 3, Issue 6, Page No: 306-315
November-December 2020

Spectrum of Salivary Gland Pathologies in Diagnostic Ultrasound- A Retrospective Study

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Type of Publication: Original Research Paper
Conflicts of Interest: Nil

ABSTRACT

Background & Objectives: Ultrasonography (USG) has been shown to be a highly sensitive means of evaluating the major salivary glands. It is difficult to differentiate between salivary gland pathologies by clinical examination alone [1]. So the aim of this study is to outline the spectrum of salivary gland pathologies using USG with Colour Doppler (Duplex Ultrasound) and to validate the performance indicators in terms of sensitivity, specificity and diagnostic accuracy with respect to clinical diagnosis/ histopathology report [HPR] as gold standard. **Methodology:** The retrospective USG images of cases from July 2017 to January 2019 from the archived database of the Dept. of Oral Medicine and Radiology in Tertiary teaching hospital were used. **Results & Discussions:** Out of the 59 cases(M=32, F=27) of salivary gland pathologies, the cases were grouped as 16(27%) cases of sialadenitis, 12(20%) cases of sialolithiasis, 10(17%) cases of salivary gland neoplasm, 17 (29%) cases of mucocele and 4(7%) cases of ranula. In our study the sensitivity of USG in acute sialadenitis was 88.88%.In sialolithiasis, salivary gland neoplasm, mucocele and ranula the sensitivity was 100%. But the malignant nature could only be better ascertained following advanced diagnostic modalities/FNAC. The intraductal and intra glandular sialoliths can be differentiated with the help of USG. **Conclusion:** Duplex ultrasound can be used as a valuable diagnostic adjunct along with the clinical assessment for salivary gland diseases in oral medicine clinics.

Keywords: Ultrasonography (USG), Salivary gland pathologies, Diagnostic duplex ultrasonography

INTRODUCTION

The technological advances in high-resolution transducers and the superficial location of the major salivary glands, makes it most accessible by USG [2]. The in-office use of USG in oral medicine clinics for evaluation of salivary gland pathologies will help to have a better idea about the lesion. USG is widely available, relatively inexpensive, and non-invasive. It is a low-cost alternative to CT or MRI for evaluating the superficial lobe lesions of salivary glands. But USG is operator dependent and it is sometimes not possible to visualize examined lesions completely at USG because of their location, penetrating to the deep lobe of the parotid gland or behind the acoustic shadow of the mandible [2]. Also, in cases of suspected malignant lesions, further diagnostic methods (i.e., CT or MRI) should be applied to assess possible infiltration of bones or deeper structures invisible at USG (the base of the skull, parapharyngeal space and to evaluate deep-lying lymph nodes) [3]. Here we are evaluating the potential of in-office use of USG in oral medicine clinic for assessment of salivary gland pathologies which can

decrease the need for additional diagnostic imaging and which will help the clinician to have more precision in diagnosis and for better management of patients.

AIM

To outline the spectrum of salivary gland pathologies using Ultrasonography with Colour Doppler (Duplex Ultrasound)

Objectives

- To report pattern of intraoral and transcutaneous ultrasonographic image of salivary gland pathologies with respect to standard criteria for interpretation of sonogram.
- To validate the performance indicators in terms of sensitivity, specificity and diagnostic accuracy with respect to clinical diagnosis /histopathology [HPR] report as gold standard.

METHODOLOGY

Duplex Ultrasound (SONOSCAPE SSI- 4000) is routinely used for diagnosis in Oral Medicine clinic of Tertiary teaching hospital. The retrospective Ultrasound (USG) Images of 304 patients from July 2017 to January 2019 from the archived database of the Department of Oral Medicine and Radiology, is used in this study.

Out of these the patients with salivary gland pathologies (n=59) were taken. Transcutaneous followed by intraoral ultrasonographic examination including color doppler evaluation was performed using a systematic scanning protocol in these cases. The study sample [n=59] has mean age of 37.36 ± 14.75.out of this there were 32 males and 27 females. The age and gender distribution of the cases are shown in (Fig.1).

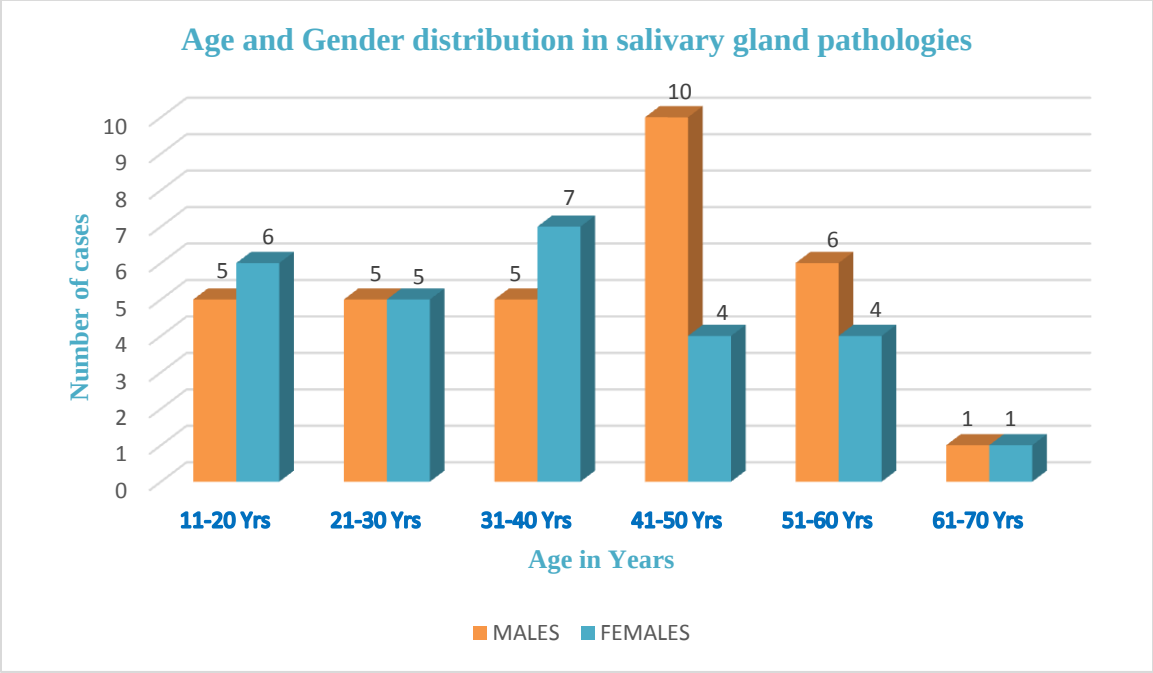

Figure 1: showing age and gender distribution of cases with salivary gland pathologies

Cases were grouped as 17(29%) cases of mucocele, 16(27%) cases of sialadenitis, 12(20%) cases of sialolithiasis, 10(17%) cases of salivary gland neoplasm, and 4(7%) cases of ranula (Fig.2).

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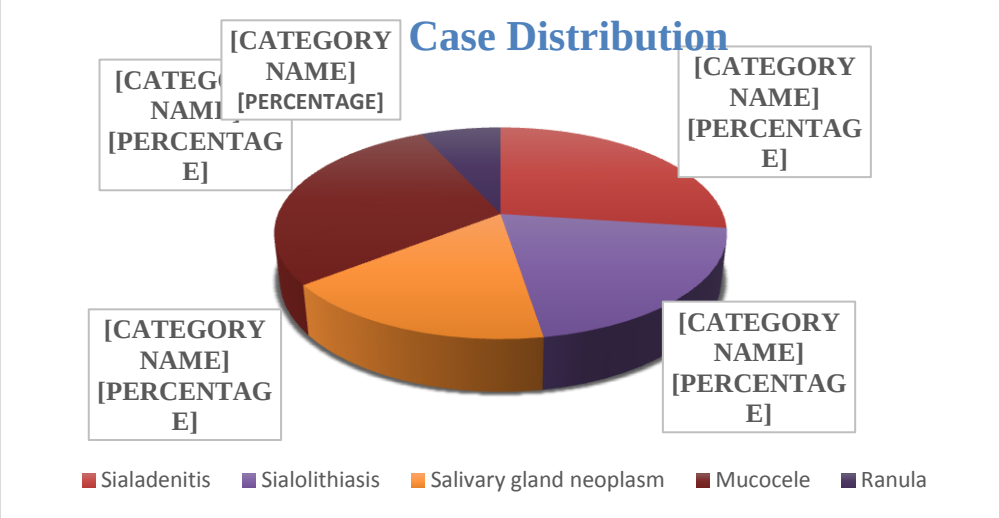

Figure 2: Showing case distribution of salivary gland pathologies

Ultrasonography Machine:

SonoScape SSI- 400

Probes: 1. Linear probe (7-10MHz)

2. Intracavitary probe (6.9-12MHz) and

3. Hockey stick probe (intraoperative) (10-15MHz)

Scanning was performed with the patient in supine or semi reclined position, their head in position with the examiners knees. The examiner was positioned on the right side of the patient where the ultrasound apparatus was placed. The scanning was performed in longitudinal, transverse, intraoral and transcutaneous positions, in a continuous sweep technique. In intraoral examination, the transducer with lower frequency was placed directly on the surface of tumour for deeper lesions and with a higher frequency for superficial lesions which allowed the evaluation of the thickness, echogenicity and vascularity of the lesion on doppler application. Sonogram was obtained with high resolution real time imaging. Ultrasound findings were documented with special reference to shape, border, internal architecture, size, echo distribution, vascularity and echogenicity. Colour Doppler facility was used for relevant cases. All cases were the lesions resolved/biopsy could not be attempted, clinical diagnosis was taken as confirmatory.

The cases diagnosed as sialadenitis, sialolithiasis and ranula were compared with their clinical reports. The sonographically diagnosed cases of mucocele, salivary gland neoplasm were compared with its histopathology reports also and sensitivity, specificity, diagnostic accuracy of ultrasound in detecting each of the lesions were found out.

TECHNIQUE OF ULTRASONOGRAPHY [4]

7 SWEEP TECHNIQUES

Sweep 1 – Submental

The first sweep is from chin to hyoid in the midline. The structures seen here are the anterior belly of digastric, geniohyoid, mylohyoid and sublingual salivary glands.

Sweep 2: Submandibular

The second sweep is from chin to angle of mandible by following mylohyoid. The main anatomical structures that can be appreciated are the submandibular salivary glands, anterior and posterior belly of digastric, mylohyoid, and hyoglossus.

Sweep 3: Parotid

The third sweep is from external auditory meatus to angle of the mouth by following parotid duct. The structures seen here are parotid salivary glands, posterior belly of digastric, masseter muscles. Buccal pad of fat can also be appreciated here.

Sweep 4: Deep cervical chain

This fourth sweep is starting from angle of jaw to sternoclavicular joint following internal jugular vein. Jugulodigastic nodes, sternocleidomastoid muscles, thyroid gland etc... can be spotted out here.

Sweep 5: Transverse cervical

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This sweep is from sternoclavicular joint to acromioclavicular joint which follows clavicle.

Sweep 6: Posterior triangle

This is from acromioclavicular joint to mastoid tip following anterior border of trapezius.

Sweep 7: Anterior neck

The seventh sweep is from Hyoid to sternal notch. The main structures are larynx and thyroid glands.

This 7 sweep technique has been summarised in (Fig.3)

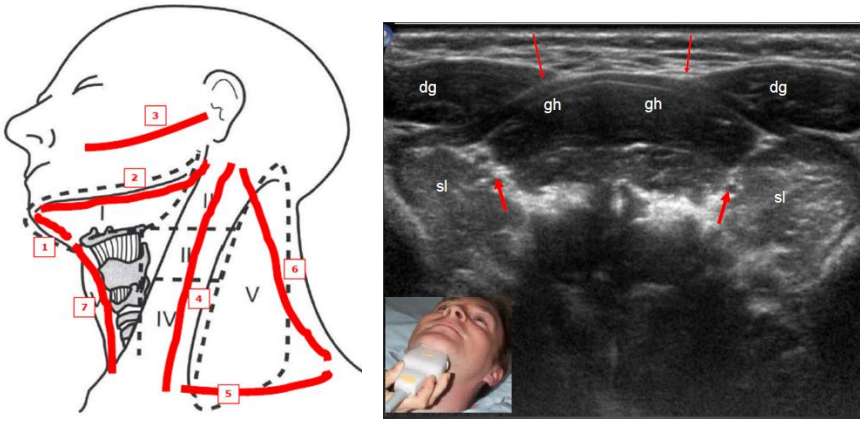

Fig.3:-The seven sweep technique. The figure on the right side showing first sweeps dg-digastric, gh-geniohyoid, sl-sublingual salivary gland [4].

RESULTS

Out of 59 patients of salivary gland pathologies 32 cases were males and 27 were females. The male to female ratio was 1.9:1. The mean age of the study population was 37.36 with a standard deviation of 14.75. In our study16 cases were that of sialadenitis, 12 cases were that of sialoloithiasis and salivary gland neoplasm comprises of 10 cases, 17 cases were that of mucocele and the rest of the 4 cases were that of ranula. The performance indicators of USG V/S Clinical diagnosis is shown in Table.1.

Table 1: Performance indicator of USG versus Clinical diagnosis

Diagnosis	USG versus clinical		Sensitivity	Specificity	Accuracy
	An	Bn	An÷(An+Cn)	Dn÷(Bn+Dn)	An+Dn ÷(An+Bn+Cn +Dn)
	Cn	Dn			
Sialadenitis	16	0	88.88%	100%	96.61%
	2	41			
Sialolithiasis	12	0	100.00%	100.00%	100.00%
	0	47			
Ranula	4	0	100.00%	100.00%	100.00%
	0	55			
Mucocele	17	0	100.00%	100.00%	100.00%
	0	42			

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Salivary gland neoplasm	10	0	100.00%	100.00%	100.00%
	0	49			

ULTRASONOGRAPHIC FEATURES OF SALIVARY GLAND PATHOLOGIES

Inflammatory diseases

Acute Sialadenitis

In our study sample there were 16 (27%) cases of acute sialadenitis with10 males and 6 females. Their average age was 40.68 ± 16.16.Sensitivity of USG in acute sialadenitis was 88.88%, specificity was 100% and diagnostic accuracy was 96.61%.

In acute inflammation, salivary glands are enlarged, hypoechoic, with no evidence of posterior acoustic enhancement with well-defined borders and increased vascularity on colour Doppler (Fig.4).Many studies showed that in sialadenitis, the gland may be inhomogeneous; may contain multiple small, oval, hypoechoic areas; and may have increased blood flow at USG. Enlarged lymph nodes with increased central blood flow can also be observed in acute inflammation of the salivary glands [1-3,5, 6].

Fig.4: A 31 year old male with swelling over the right parotid region with increased vascularity seen on the right superficial lobe of parotid in acute sialadenitis

Sialolithiasis

There were 12(20%) cases of sialolithiasis in our study with 4 males and 8 females. Mean age among them was 39.75 ±12.44. Sensitivity of USG in our study for sialolithiasis was 100%, specificity and diagnostic accuracy was 100%.In our study, sialolithiasis were seen as discrete hyperechoic areas with well-defined margins with distal acoustic shadowing and no increased vascularity on colour Doppler.

Sialolithiasis causes partial or total mechanical obstruction of the salivary duct, which results in recurrent swelling of a salivary gland while consuming food and may be complicated by bacterial infection. In symptomatic cases with duct occlusion, dilated excretory ducts are visible. In patients suffering from obstructive disease, ascorbic acid stimulation improved the diagnostic quality of the sonograms [7]. Sonographically, lithiasis typically appears as a bright curvilinear echo complex with posterior shadowing. In lesions smaller than 2 mm, this shadow may be missing [2, 3, 6, 8-10] (Fig.5).

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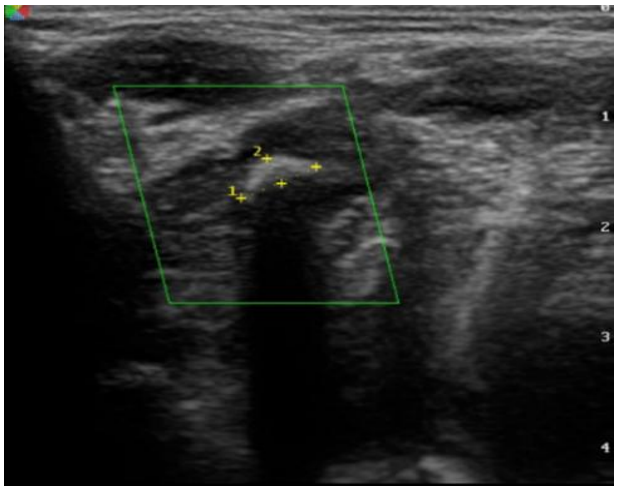

Fig.5: A 17 year old female with a swelling on the right side of jaw with pain during food intake which was a case of sialolithiasis seen as hyperechoic areas with distal acoustic shadowing and no evidence of vascularity on Color Doppler.

Salivary gland neoplasm

In our study there were 10(17%) cases of salivary gland neoplasm with 6 males and 4 females. Mean age among them was 46.3± 9.39. Sensitivity of USG was 100%, specificity was 100%, and diagnostic accuracy was 100%.

Benign Neoplasms

The most common benign neoplasms of major salivary glands are pleomorphic adenomas (mixed tumour) and warthin tumours (adenolymphoma, cystadenolymphoma, papillary cystadenoma lymphomatosum). Clinically, they manifest as slowly growing painless masses. However, small lesions may be detected incidentally at USG. When their sonographic appearance is analysed, many common features may be found, but definitive differential diagnosis is usually not possible with USG even between benign and malignant tumour [1-3, 8].

Fig.6:- 48 year old male with a swelling on right side of face .Case of pleomorphic adenoma showing lobulated margins with posterior acoustic enhancement

At USG, pleomorphic adenomas are seen as lesions with well-defined and lobulated margins with posterior acoustic enhancement and mixed echoic internal architecture. The feature of lobulated margin

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is being emphasized in differential diagnosis (Fig.6). The Warthin's tumors also show similar characteristics in USG. It is difficult to differentiate between the benign tumours from the USG images alone.

Malignant salivary gland neoplasm

The macroscopic appearance of the tumour, and similarly its imaging features, depend mostly on the level of malignancy. Well-differentiated tumours may be similar to benign tumours at USG .Adenoid cystic carcinoma, which is a slowly growing tumour, shows a particular tendency to nerve infiltration (and thus pain), and late metastases are frequent. Sonographic features of malignant salivary neoplasms include the following: an irregular shape, irregular borders and a hypoechoic inhomogeneous structure [1-3, 8].

However, malignant tumors may also be homogeneous and well defined in USG. The internal structure of a malignant tumour at USG may be not only solid but also cystic or cystic with a mural solid nodule.

Malignant tumors may have a lobulated shape, similar to that of pleomorphic adenomas. Vascularization of malignant tumors is not pathognomonic, and assessment with Color Doppler does not allow reliable differentiation between benign and malignant salivary gland tumors [1-3, 8].

However, high vascularization and high systolic peak flow velocity should raise the suspicion of malignancy [1-3, 8] (Fig.7).

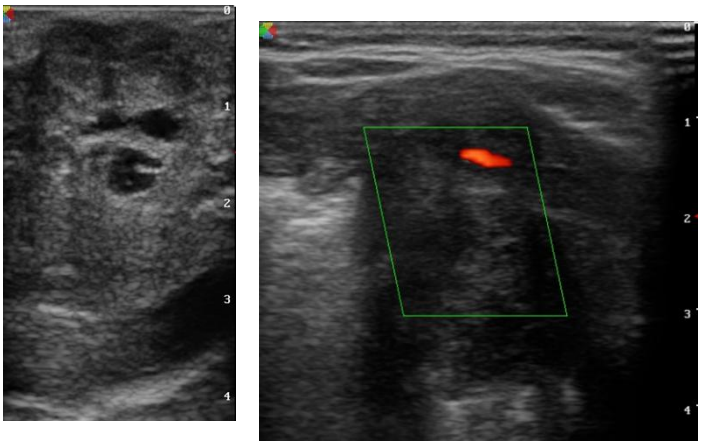

Fig.7:- Ultrsanographic images of 41 year old male with swelling on the floor of mouth showing irregular borders, hypoechoic areas and increased vascularity on colour doppler suggestive of malignant lesion.

Ranula

There were 4(7%) ranula cases, with 1 male and 3 females with mean age of 18.5 ± 6.24.Anechoic areas with well-defined borders and posterior acoustic enhancement seen. USG features of a cyst are classic (like in any other location in the body) well-defined margins, anechoic content, posterior acoustic enhancement, and no evidence of internal blood flow at Color Doppler imaging [1,3] .Ranula can either be a simple ranula confined to the floor of mouth limited by mucous membrane, or it can be a plunging ranula which has extension beyond the mylohyoid muscle, as a swelling in the neck. USG can differentiate between these two varieties of ranula. (Fig.8).

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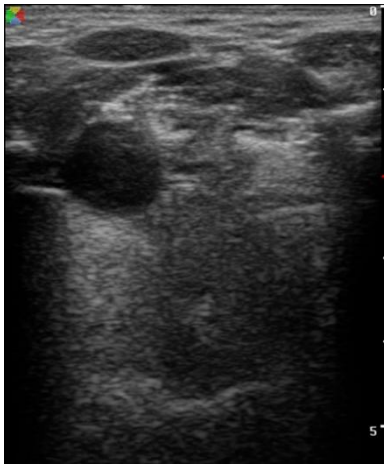
Simple Ranula (Intraoral Image)



Plunging Ranula (Extraoral Image)

Fig.8:- 26 year old female with fluid filled swelling on the floor of mouth seen as anechoic content with posterior acoustic enhancement

Mucocele

17(28.8%) mucocele cases with 12 males and 5 females was there with a mean age of 30.41 ± 15.02. Oral mucocele is the most common benign minor (accessory) salivary gland lesion, caused due to mechanical trauma to the excretory duct of the gland. Clinically they are characterised by single or multiple, soft, fluctuant nodule, ranging from the normal colour of mucosa to deep blue. It affects at any age and is equally present in both sexes with highest incidence in the second decade of the life. They are classified as extravasation or retention type[1-3,8].

In USG they can be seen as well-defined homogeneously anechoic area with posterior acoustic enhancement and no increased vascularity on Colour Doppler (Fig.9).

Fig.9:- 58 year old male with a swelling on the lower lip with well-defined anechoic area with posterior acoustic enhancement seen in case of mucocele

DISCUSSION

In most clinical situations, USG is the first-line imaging method in the evaluation of the major salivary glands. In our study sensitivity of USG in acute sialadenitis was 88.88%., in sialolithiasis, salivary gland neoplasm, ranula and mucocele it was 100%. In inflammation and infection, it can differentiate obstructive and non-obstructive sialadenitis. In sialolithiasis, it can differentiate intraductal from intraglandular lithiasis and visualize radiotransparent lithiasis [2].

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USG is very sensitive in detecting tumors and lymph nodes. Superficial tumors can be delineated, whereas large or deeply located tumors usually require MRI. The specificity of USG in differentiation between benign and malignant nature of tumors is limited [2].

Liu et al [12] (2015) compared USG, CT, MRI for differential diagnosis of patients with salivary gland tumours. And the pooled sensitivity of USG was found to be 0.629(95% CI). Pniak et al [13] (2016) found that sensitivity of USG in diagnosis of sialolithiasis was 71.9%.

The specificity of ultrasound in our study was 100% for all salivary gland pathologies. Thakkar et al[14] (2017) found that the specificity of USG for salivary gland neoplasm was 85.7%.

Diagnostic accuracy of USG in acute sialadenitis in our study was 96.61%, for sialolithiasis, salivary gland neoplasm, ranula and mucocele accuracy was 100%.some of the similar results in agreement with our study seen in literature are as follows

Kats et al (2009)[2] showed that the accuracy of USG in the assessment of sialolithiasis was approximately 90%.

Bozatto et al (2009)[7] found out that in patients suffering from obstructive disease, ascorbic acid stimulation improved the diagnostic quality of the sonograms in 95% of cases.

Anna et al in 2017 [15] and. Bialek et al [3] concluded that USG is a valuable and useful method for diagnosis of salivary gland diseases. Not only does it enable confirmation or exclusion of the presence of a mass, but in many cases the nature of underlying disease may also be suggested on the basis of USG findings.

CONCLUSION

USG is a valuable and useful method for diagnosis of salivary gland diseases. It is radiation free and cost effective too. Even though USG has its own limitation it can still be used for initial diagnostic workup in salivary gland pathologies with reliable accuracy in oral medicine clinics.

Depending on the size, site, echo texture, margins and vascularity of the salivary glands in diagnostic duplex ultrasound, we were able to assess and differentiate salivary gland pathologies from lymphadenitis. We were also able to differentiate benign salivary lesions from malignant lesions up to certain extend. The intraductal and intra glandular sialolithiasis can be differentiated. The USG findings were of high diagnostic accuracy and it helped to confirm the extent and nature of lesions more precisely. Also, in cases of suspected malignant lesions, further diagnostic methods (i.e., CT or MR imaging) should be applied to assess possible infiltration of bones or deep structures invisible at USG (the base of the skull, parapharyngeal space) and to evaluate deep-lying lymph nodes. The effective in office use of ultrasound imaging in oral medicine clinic helps the clinician to have a better clarity about the case and to arrive at the diagnosis more easily.

CONFLICT OF INTEREST

The authors report no conflict of interest

ACKNOWLEDGEMENTS

Patients enrolled in the study and all the staff in the department of Oral Medicine and Radiology, Govt. Dental College, Kozhikode,Kerala,India

This paper has got Third place in the XVII National Triple O Symposium 2019 held at Mumbai from15th -17th March 2019

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