Print ISSN: 2321-6379
Online ISSN: 2321-595X
DOI: 10.17354/ijss/2018/59

Original Article

# To Know the Diagnostic Accuracy of Ultrasonography for Major Salivary Gland Masses and Its Correlation with Histopathological Examination

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## Abstract

**Introduction:** Major salivary gland pathologies are a significant source of morbidity in general population. The role of ultrasonography (USG) in the evaluation of salivary gland masses is become increasingly important due to the availability of high-frequency probe which permit visualization of more subtle anatomical and pathological details.

**Aims and Objectives:** The aim of this study is to know the reliability of USG as a diagnostic tool for the assessment of masses of major salivary gland.

**Materials and Methods:** The study was conducted in the Department of Radiodiagnosis, Gajra Raja Medical College and J.A. Group of Hospitals, Gwalior (Madhya Pradesh), in USG Machine SSD4000SV (Aloka Trivitron) from August 2011 to October 2012. A total 124 patients was enrolled in study after taking detailed history and relevant clinical examination. Subsequently, the patient was subjected to high-resolution USG followed by histopathological examination (HPE).

**Results:** According to the study, non-neoplastic pathologies 78 (62.9%) were more common than neoplastic salivary gland pathologies 46 (37.1%). Of 46 neoplastic pathologies, benign tumors 32 (69.57%) were more common than malignant 14 (30.43%). The age distribution of the patients with salivary gland neoplasm ranged from 1-80 years and Majority of belongs to the 30-70 years age group. Benign tumors were more common in 30–40 years age group. Malignant tumors were more common after 50 years of age. Male:female ratio for malignant tumors is 6:1 and equal in benign tumors. Parotid gland was the most common site accounting for 91.30% followed by submandibular gland (8.7%) of all salivary gland tumors. On USG examination, all tumors were hypoechogenic. Most benign tumors (87.5%) had well-defined borders, but 12.5% of malignant tumors also had well-defined (sharp) borders. The internal structure of tumor was not a relevant indicator of malignancy. According to the study, the most common tumors were pleomorphic adenoma which accounted for 60.87% of all cases followed by mucoepidermoid carcinoma (17.4%) of all cases confirmed by HPE.

**Conclusion:** In our study, an excellent correlation was seen in the diagnosis of salivary gland masses between sonography (grayscale and color Doppler sonography [CDS]) and histopathology. Sonography (grayscale and color Doppler together) was found to be highly sensitive and specific in the diagnosis of salivary gland masses; however, it is more sensitive for detecting benign tumors and more specific for malignant tumors.

**Key words:** Adenocarcinoma, Color Doppler, Neoplasm, Pleomorphic adenoma, Salivary glands, Ultrasonography

Access this article online

www.ijss-sn.com

Month of Submission : 12-2017
Month of Peer Review : 01-2018
Month of Acceptance : 01-2018
Month of Publishing : 02-2018

## INTRODUCTION

Major salivary glands (parotid, submandibular, and sublingual) pathologies are a significant source of morbidity in general population. Salivary gland masses are commonly encountered by surgeon and radiologist in daily practice. Clinical examination is alone often insufficient to identify

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the origin and nature of lesion. Imaging is required in the vast majority of cases. Sonography is first imaging modality after clinical examination.[1,2] Ultrasound is used to identify focal salivary gland mass, whether it is intraglandular or extragrandular.[3] Color Doppler may help in diagnosing malignancy when there is disorganized internal color flow. The accuracy can be further enhanced by fine-needle aspiration cytology (FNAC) under ultrasound guidance.[4] Computed tomography (CT) and magnetic resonance imaging (MRI) are best diagnostic aid, but both are highly expensive and not universally available.[5-7] So we can say that Sonography, being a real-time, non-invasive, painless, relatively inexpensive and radiation free imaging modalities for the assessment of masses of major salivary gland.

### Aims and Objectives

The aim of this study is to know the reliability of ultrasonography (USG) as a diagnostic tool for the assessment of masses of major salivary gland (benign/malignant neoplasm).

## MATERIALS AND METHODS

The present study was conducted in the Department of Radiodiagnosis, G.R. Medical College and J.A. Group of Hospitals, Gwalior (Madhya Pradesh), in USG Machine SSD4000SV from August 2011 to October 2012. The informed consent and detailed history were taken, and relevant clinical examination was done. Subsequently, the patients were subjected to sonography.

The following sonographic parameters were studied in each case:

1. Size
2. Echogenicity
3. Echotexture
4. Vascularity
5. Ductal system of salivary gland
6. Bilateral cervical region for evidence of cervical lymphadenopathy.

FNAC/histopathology was done to confirm the sonographic diagnosis.

### Inclusion Criteria

A total of 124 patients of all age groups attending the various outdoor and indoor departments of hospital with signs and symptoms related to salivary gland masses were included in the study.

### Equipment

All the ultrasound examination was performed with real-time sonography equipment SSD4000SV (Aloka Trivitron Pvt. Ltd., Tokyo Japan) using linear array transducer of frequency 7–12 MHz. As and when required 3.5 transducer was also used for adequate penetration, particularly in case of large salivary gland swelling.

### Statistical Analysis

The SPSS software package was used for the analysis. Statistical significance was defined as a $p<0.05$. Student's *t*-test and Chi-square test were used to calculate the significance between the variables.

## OBSERVATIONS

A total of 124 patients with clinical symptoms pertaining to the salivary gland pathologies were assessed byhigh-resolution ultrasound and results showed that majority of 96 (77.4%) patients with salivary gland diseases belonged to ≤50 years of age. Male to female ratio is 1.3:1 [Table 1].

In sonographic findings, non-neoplastic salivary gland pathologies were more common 78 (62.9%) than neoplastic salivary gland pathologies 46 (37.1%) [Table 2]. Of 46 neoplastic pathologies, benign tumors were 32 (69.57%) and malignant tumors were 14 (30.43%) [Table 3]. Majority of the tumor in this study occurred between the ages from fourth to sixth decades. Benign tumors were more common in 30–40 years age group patients, whereas malignant tumors were common after 50 years. Male:female ratio 1:1 for benign tumors and 6:1 for malignant tumors were observed [Table 4].

In the study Parotid gland was the most common site accounting for 42/46 (91.30%) followed by submandibular gland 4/46 (8.7% ) of all salivary gland tumors, All of 42 parotid tumours 30( 71.4 %) were benign and 12( 28.5%) were malignant. where's in submandibular gland 50% were benign and 50% were malignant tumors (Table 5). All patients presented with swelling. Features of rapid growth, pain, and associated facial paralysis were considered as signs of malignancy. Ten of 46 patients presented with pain in swelling, all are malignant. Pain occurred in 71.4% of malignant tumors. Two patients with malignant tumor presented with facial nerve palsy accounting for 4.3%. Deep lobe involvement was seen in 2 patients presenting as parapharyngeal masses, in malignant tumour accounting for 4.3% of all tumors. 4 patients with malignant tumor presented as lymph node swelling in the cervical region 8.7% of all tumors [Table 6]. All tumors were hypoechogenic compared with the surrounding parenchyma. Most benign tumors (87.5%) had well-defined borders, but 12.5% of malignant tumors also had well-defined (sharp) borders. The internal structure of tumor was not a relevant indicator of malignancy. The color Doppler sonography (CDS) examination revealed that 68.7% of benign and 28.7%

**Table 1: Distribution of patients according to age and sex**

| Age in years | *n* (%) | | |
|---|---|---|---|
| | Male | Female | Total |
| 1–10 | 6 (4.84) | 8 (6.45) | 14 (11.29) |
| 11–20 | 12 (9.68) | 8 (6.45) | 20 (16.13) |
| 21–30 | 14 (11.29) | 14 (11.29) | 28 (22.58) |
| 31–40 | 12 (9.68) | 8 (6.45) | 20 (16.13) |
| 41–50 | 10 (8.06) | 4 (3.23) | 14 (11.29) |
| 51–60 | 6 (4.84) | 10 (8.06) | 16 (12.90) |
| 61–70 | 8 (6.45) | 2 (1.61) | 10 (8.06) |
| 71–80 | 2 (1.61) | 0 (0.00) | 2 (1.61) |
| Total | 70 (56.45) | 54 (43.55) | 124 (100) |

**Table 2: Distribution of cases according to pathology**

| Salivary gland pathology | No. of cases (%) |
|---|---|
| Non-neoplastic | 78 (62.9) |
| Neoplastic | 46 (37.1) |

**Table 3: Relative frequency of benign and malignant major salivary gland tumor**

| Type of tumor | Number of cases (%) |
|---|---|
| Benign | 32 (69.57) |
| Malignant | 14 (30.43) |
| Total | 46 (100) |

**Table 4: Age distribution of patients with salivary gland neoplasm**

| Age in years | *n* (%) | | |
|---|---|---|---|
| | Benign | Malignant | Total |
| 0–10 | 2 (4.35) | 0 (0.00) | 2 (4.35) |
| 10–20 | 2 (4.35) | 0 (0.00) | 2 (4.35) |
| 21–30 | 2 (4.35) | 0 (0.00) | 2 (4.35) |
| 31–40 | 14 (30.43) | 2 (4.35) | 16 (34.78) |
| 41–50 | 6 (13.04) | 2 (4.35) | 8 (17.39) |
| 51–60 | 4 (8.70) | 2 (4.35) | 6 (13.04) |
| 61–70 | 2 (4.35) | 6 (13.04) | 8 (17.39) |
| 71–80 | 0 (0.00) | 2 (4.35) | 2 (4.35) |
| Total | 32 (69.57) | 14 (30.43) | 46 (100.00) |

**Table 5: Site distribution of salivary gland neoplasm**

| Salivary gland | Benign | Malignant | Total (%) |
|---|---|---|---|
| Parotid | 30 | 12 | 42 (91.30) |
| Submandibular | 2 | 2 | 4 (8.7) |
| Sublingual | 0 | 0 | 0 (0) |
| Total | 32 | 14 | 46 (100) |

of malignant tumors were poorly vascularized [Table 7]. In this study, all neoplastic USG diagnosis confirmed by histopathological examination (HPE) and found that the

**Table 6: Mode of presenting symptoms of salivary gland tumors**

| Symptoms | Number of patients (%) |
|---|---|
| Swelling | 46 (100) |
| Pain | 10 (21.7) |
| Facial palsy | 2 (4.34) |
| Cervical node swelling | 4 (8.7) |
| Parapharyngeal mass | 2 (4.34) |

**Table 7: Ultrasonographic features of benign and malignant salivary gland tumor histological diagnosis**

| Parameter | *n* (%) | |
|---|---|---|
| | Benign tumor (*n*=32) | Malignant tumor (*n*=14) |
| Shape | | |
| Lobulated | 14 (43.75) | 2 (14.29) |
| Ovoid | 10 (31.25) | 0 (0.00) |
| Irregular | 8 (25.00) | 12 (100.00) |
| Margin | | |
| Well defined (sharp) | 28 (87.50) | 2 (14.29) |
| Ill defined | 4 (12.50) | 12 (85.71) |
| Echogenicity | | |
| Anechoic | 0 (0) | 0 (0.00) |
| Hypoechoic | 32 (100) | 14 (100.00) |
| Isoechoic | 0 (0) | 0 (0.00) |
| Hyperechoic | 0 (0) | 0 (0.00) |
| Echotexture | | |
| Homogeneous | 12 (37.5) | 0 (0.00) |
| Non-homogeneous | 20 (62.50) | 14 (100.00) |
| Calcifications | 10 (31.25) | 4 (28.57) |
| Cystic areas | 4 (12.50) | 4 (28.57) |
| Vascularization | | |
| Absent | 2 (6.25) | 0 (0.00) |
| Poorly vascularized | 22 (68.75) | 4 (28.57) |
| Well vascularized | 8 (25.00) | 10 (71.43) |

pleomorphic adenoma was most common which accounted for 60.4% followed by mucoepidermoid carcinoma[Figure 1] was commonest which accounted 60.4% followed by mucoepidermoid carcinoma [Figure 2]), 17.4% and accounting for Adenocarcinoma 4.35% [Figure 3] of all cases [Table 8]. Overall in our study, USG showed a sensitivity of 100% and specificity of 87.5% for benign tumors and 87.5% sensitivity and 100% specificity malignant tumors.

## DISCUSSION

The present study was undertaken to evaluate the role of high-frequency USG and CDS in the evaluation of salivary gland pathology.

### Distribution of Salivary Gland Diseases by Age and Sex

A total of 124 patients with clinical symptoms pertaining to the salivary gland pathologies were assessed by high-resolution ultrasound and results showed that majority of

**Table 8: The distribution of benign and malignant tumors, according to histological type**

| Diagnosis | Sonographic diagnosis | Histopathological examination |
|---|---|---|
| Benign | 34 | 32 |
| Malignant | 12 | 14 |

| Salivary gland tumor | Cases *n*=46 (%) |
|---|---|
| Benign | |
| Pleomorphic adenoma | 28 (60.87) |
| Warthin's tumor | 2 (4.35) |
| Hemangioma | 2 (4.35) |
| Malignant | |
| Mucoepidermoid carcinoma | 8 (17.39) |
| Adenoid cystic carcinoma | 2 (4.35) |
| Adenocarcinoma | 2 (4.35) |
| Pleomorphic ex carcinoma | 2 (4.35) |

96 (77.4%) patients with salivary gland diseases belonged to <50 years of age. Male-to-female ratio is 1.3:1.

In sonographic findings, non-neoplastic salivary gland pathologies were more common 78 (62.9%) than neoplastic salivary gland pathologies 46 (37.1%). Of 46 neoplastic pathologies, benign tumors were 32 (69.57%) and malignant tumors were 14 (30.43%). Majority of the tumor in this study occurred between the age from fourth to sixth decades. Benign tumors were more common in 30–40 years age group patients, whereas malignant tumors were common after 50 years. Male:female ratio 1:1 for benign tumors and 6:1 for malignant tumors were observed.

Silvers *et al.*,[8] Renehan *et al.*,[9] and Ellis *et al.*[10] found that pleomorphic adenoma occurred in the fourth and fifth decades of life but may arise at any age. Renehan *et al.*[9] described a slight predominance in women.

Two patients with Warthin's tumor and two patients with hemangioma were seen in the 61–70 and 1–10 years of age group, respectively, and both were males.

Renehan *et al.*[9] and Ellis *et al.*[10] reported that Warthin's tumor was the most common in elderly males in the fifth and sixth decades of life. Baker *et al.*[11] described that infantile hemangioma was the most common vascular lesion in infancy and childhood.[11]

Malignant salivary gland tumors were observed in 14 (11.3%) patients comprised of 12 (9.7%) males and 2 (1.6%) females. Musani *et al.*[12] also reported that malignant tumors were more common in males.

### Sonographic Features of Salivary Gland Disease

Sonography can be used to visualize all of the submandibular and sublingual salivary glands and the entire parotid gland, except for the portion obscured by the acoustic shadow of the mandible.

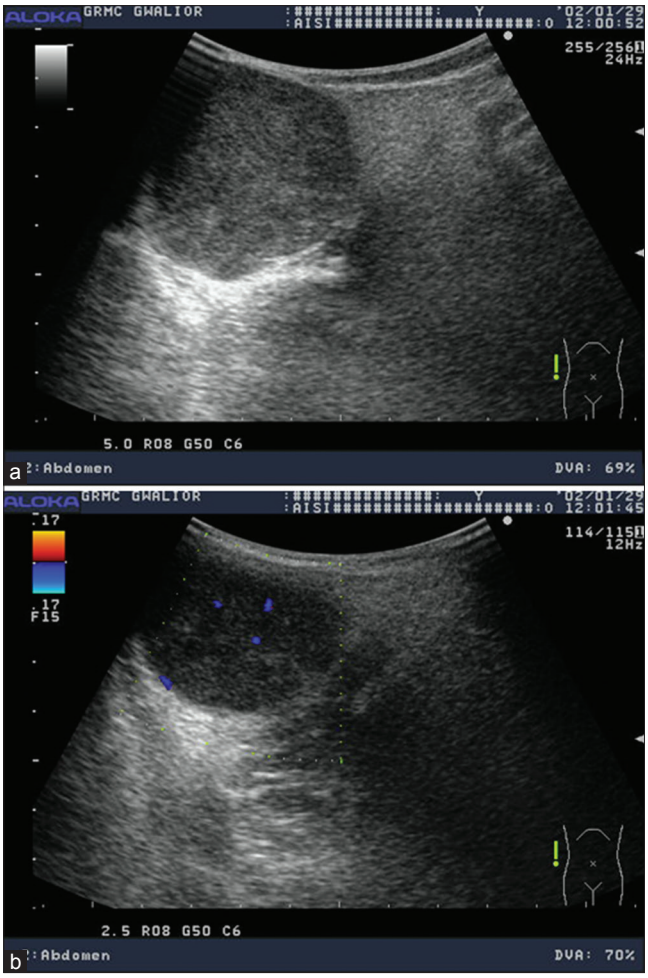


**Figure 1: (a and b) Grayscale and color Doppler ultrasonography image of pleomorphic adenoma of right parotid gland**

### Neoplasm

Tumors were diagnosed by sonography in 46 patients, 42 were seen in the parotid gland, and 4 were seen in the submandibular gland. All palpable lesions were shown sonographically. Hence, in our study, the sensitivity of sonography in the detection of salivary gland tumors was 100%.

Of these 46 patients with salivary gland neoplasm, the final pathological diagnosis included 14 malignant tumors and 32 benign masses. The presumed sonographic diagnoses showed 34 cases as benign and probably benign masses, on pathological diagnosis; 2 cases were confirmed malignant and 32 cases benign, while 12 cases were diagnosed as probably malignant and malignant masses, and all cases were confirmed malignant on pathologic diagnosis.

Of 32 cases of benign tumor, pleomorphic adenoma was seen in 28 cases, and Warthin's tumor and hemangioma

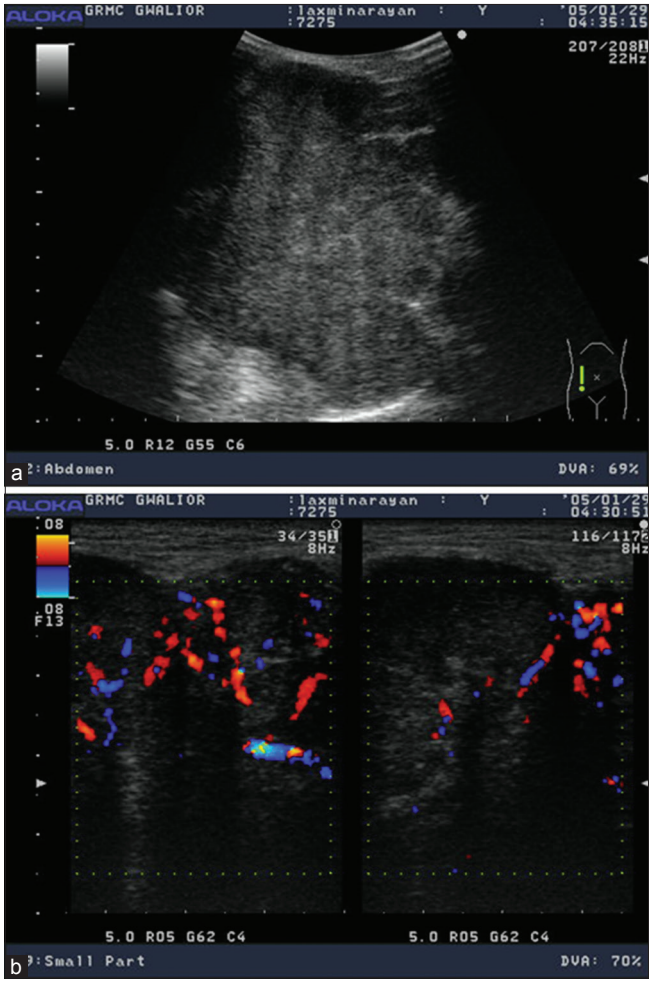


**Figure 2: (a and b) Grayscale and color Doppler ultrasonography image of adenocarcinoma of right parotid gland**

were seen in 2 cases each. Of 14 cases of malignant tumor, mucoepidermoid carcinoma was seen in 8 cases followed by adenoid cystic carcinoma, pleomorphic ex carcinoma, and adenocarcinoma with 2 cases each. The most common benign parotid tumor was pleomorphic adenoma and the most frequent malignant tumor was mucoepidermoid carcinoma.

All tumors were hypoechogenic compared with the surrounding parenchyma. Gitzmann[13] also described the similar finding.

Dumitriu *et al.*[14] described that most benign tumors (87.8%) had sharp borders, but 39.9% of malignant tumors also presented sharp borders. In our study, most benign tumors (87.5%) had well-defined margin, but 12.5% of malignant tumors also presented well-defined (sharp) margin.

Margin of tumor was the most significant criteria for differentiating between benign and malignant tumor.

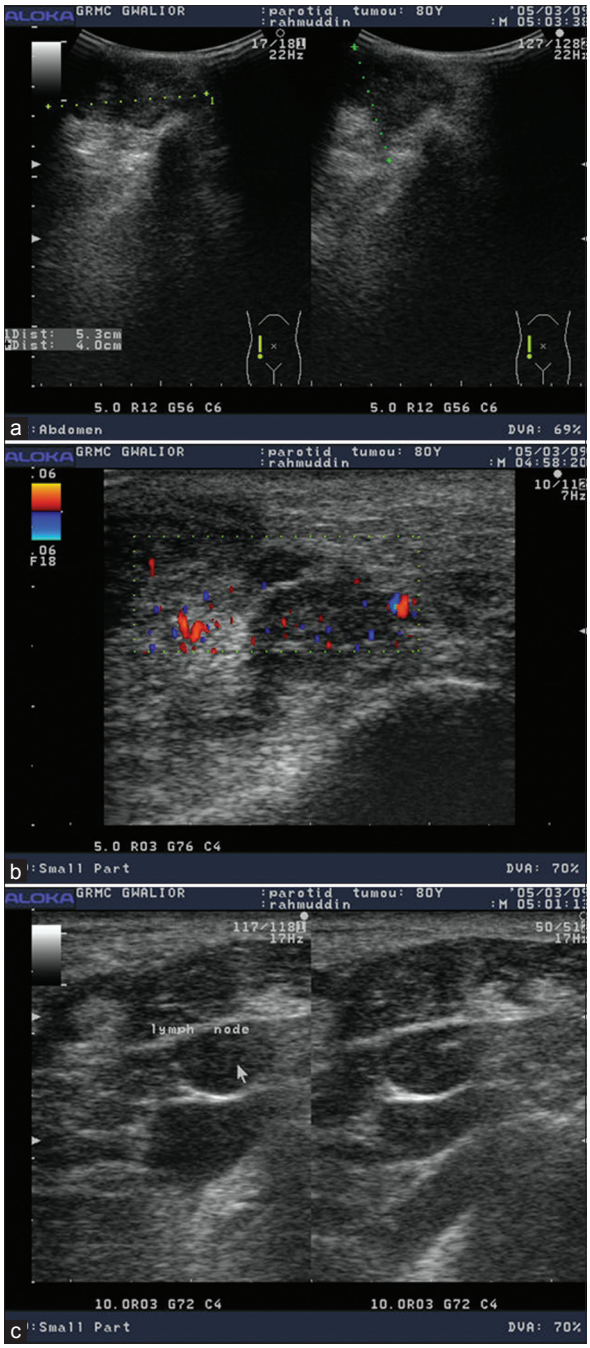


**Figure 3: (a-c) Grayscale and color Doppler ultrasonography image of mucoepidermoid of right parotid gland with cervical lymphadenopathy**

However, if this criterion alone is considered, it becomes obvious that almost 12.5% of malignant tumors would be diagnosed as benign. Out of the 4 benign tumors with ill-defined margin, 2 were hemangiomas. It was presented as heterogeneous structure. This aspect is consistent with the commonly accepted pattern for hemangiomas.

Other ultrasound features such as shape of tumor, echotexture, and vascularity were also considered in this study.

In our study, most (75%) benign tumors had either lobulated or ovoid shape, while 25% benign tumor had irregular shape. Most (85.7%) malignant tumors had irregular shape.

Dumitriu *et al.*[14] found that 51.50% benign tumor were homogenous and 48.5% were non-homogenous in echotexture. In case of malignancy, 50% were homogenous and 50% were non-homogenous.

Wu *et al.*,[15] found 9.6% of benign tumors were homogenous and 91.2% were heterogeneous (non-homogeneous). Among malignant tumors, 16.7% were homogenous and 83.3% were heterogeneous.

In our study, 37.5% of benign tumor had homogenous echotexture, while 62.5% had non-homogeneous echotexture. All malignant tumor had non-homogeneous echotexture.

Calcification was seen in 10 benign and 4 malignant tumors. Cystic areas were seen in equal number of benign and malignant tumor, i.e. 2 cases each.

Above findings suggest that echotexture of the tumor was not a relevant indicator for differentiating between benign and malignant tumor.

Dumitriu *et al.*[14] found that the on CDS examination 60.6% of benign and 55.5% of malignant tumors were poorly vascularized, while 30.30% of benign and 38.8% malignant tumors were well vascularized.

In our study, 68.75% benign tumor were poorly vascularized, 25% were well vascularized, and absence of vascularization was seen in 6.25% of patient. Among malignant tumor, 10 (71.4%) were well vascularized, and 4 (28.53%) were poorly vascularized.

Ultimately, all of these numbers confirm the fact that vessel density, as appreciated by CDS, is a reliable factor in the differential diagnosis between benign and malignant tumors, although the number of patients in the study was less. This is not consistent with other studies, which state that CDS is not enough, but that the measurement of peak flow velocity, and particularly, that of the resistance index and pulsatility index could be more useful by Bradly *et al.*

Ultrasound is also very useful for detecting regional cervical lymphadenopathy associated with salivary gland tumor.

In our study, 10 of 14, i.e., 71% of patients with malignant salivary gland neoplasm showed associated cervical lymphadenopathy. Cervical lymphadenopathy was not seen in any case with benign salivary gland neoplasm.

All the above findings show that ultrasound is very useful in the description of many features of a salivary gland tumor such as its exact location, size, shape, borders, and structure. CDS can provide accurate information about the density of vessels in the mass.

In our study in the Department of Radiodiagnosis, all cases of malignant tumor were in advanced stage, and hence, it was possible to differentiate between benign and malignant cases by 2D and color Doppler sonography; however, the accuracy was not 100% as 2 sonographically diagnosed case of benign tumor turn out to be malignant on HPE.

## CONCLUSIONS

The present study concluded that high-resolution sonography along with color Doppler should be used as first-line imaging modality in the evaluation of salivary gland masses. Sonography is a valuable primary evaluation for the visualization of salivary gland tumors. There was an excellent correlation seen in the diagnosis of salivary gland masses between sonography (grayscale and CDS) and histopathology. Sonography (grayscale and color Doppler together) was found to be highly sensitive and specific in the diagnosis of salivary gland masses; however, it is more sensitive for detecting benign tumors and more specific for malignant tumors. When a tumor cannot be delineated completely by means of sonography, CT or MRI should be performed.

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**How to cite this article:** Jain S, Jain SK. To Know the Diagnostic Accuracy of Ultrasonography for Major Salivary Gland Masses and Its Correlation with Histopathological Examination. Int J Sci Stud 2018;5(11):138-144.

**Source of Support:** Nil, **Conflict of Interest:** None declared.