Tikrit Journal for Dental Sciences 12(1) (2024) 239-253
https://doi.org/10.25130/tjds.12.1.26

Tikrit Journal
for
Dental Sciences
https://tjds.tu.edu.iq
ISSN:2073-1213

Ultrasound Evaluations of Major Salivary Gland Pathology

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Keywords:
Sialolithiasis, Major Salivary Gland pathology, ultrasonography

Article Info.:

Article History:
Received: 16/6/2023
Received in revised form: 23/6/2023.
Accepted: 3/7/2023
Final Proofreading: 3/7/2023
Available Online: 1/6/2024

Citation: **Maseer SK, Al-Aswad FD. Ultrasound Evaluations of Major Salivary Gland Pathology. Tikrit Journal for Dental Sciences 2024; 12(1): 239-253.**

https://doi.org/10.25130/tjds.12.1.26

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Abstract

No single sonographic feature is enough to distinguish gland disorders. Major salivary gland diseases are either localized or diffuse. Imaging must identify neoplastic from non-neoplastic diseases using Ultrasound, which is a non-invasive, low-cost, and accessible imaging method for the major salivary gland evaluation. Color Doppler in addition to B-mode ultrasound assesses gland enlargement and detects inflammatory, benign, and malignant gland enlargement. Moreover, this study aims to assess the diagnostic effectiveness of ultrasonography in diagnosis of major salivary gland pathology. Method: Ninety Major Salivary Gland swelling patients underwent preoperative ultra-sonography with a high-frequency linear probe. Echotexture, internal Calcification, focal lesion borders, lymphadenopathy, tumor shape, duct dilatation, and blood supply distribution were examined using color Doppler and B-mode Ultrasound. Result: A histological investigation of 62 tumors identified 18 malignant and 44 benign, with 68.2% of the benign group being pleomorphic adenoma and 61.1% of the malignant group being mucoepidermoid carcinoma. The rest of the cases, 28 cases were inflammatory, 50% of which were sialolithiasis. The sonographic features of malignant and benign differ significantly in echogenicity, posterior echo-enhancement, vascularity, morphology, and homogeneity and Calcification. All groups show considerable differences in duct dilatation, duct calcification, and homogeneity. Conclusion: Ultrasonography demonstrating excellent diagnostic efficacy in assessing salivary gland function, based on these results Ultrasonography may help reduce unnecessary biopsies especially in inflammatory cases.

Introduction:

Pathologies of the salivary glands comprise non-neoplastic lesions such as inflammations of various causes, cysts, developmental anomalies, and parenchymal lesions in systemic diseases. The other group includes neoplastic lesions, which consist of benign and malignant tumors (1). Most non-neoplastic swellings are caused by acute or chronic inflammation of the salivary glands. Regarding etiology, acute inflammation is typically caused by infection with viruses and bacteria, whereas chronic ones are caused by sialolithiasis or autoimmune

diseases (2).The incidence of inflammatory and dystrophic diseases of the salivary glands is on the rise and accounts for approximately 30% of all salivary gland diseases; salivary stones are one of the most frequent causes of obstructive salivary gland disorder, and inflammatory Sialadenitis, which is associated with sialolithiasis is approximately 50% of cases in adult. Sialolithiasis represents 40–60% of all obstructive diseases in the major salivary gland (3, 4). While Salivary tumors account for only approximately 3 to 6% of all tumors in the head and neck region (5, 6); moreover, Most tumors involve large glands, such as the parotid glands, in around 70–85% of cases. Those tumors are mostly benign in 80–95% of the cases, while malignant lesions constitute 10–17% (5, 7). Pleomorphic adenomas comprise more than 70 % of benign gland tumors. Warthin tumors follow this. (8, 9), Mucoepidermoid carcinoma accounts for 30% of all malignant salivary tumors (10) and 89% of parotid cancer cases, and in the submandibular gland at 8.4 percent(11, 12). Preoperative evaluation of major salivary gland pathologies using imaging has a significant clinical and therapeutic impact. However, it is frequently challenging due to The histological diversity of gland diseases; When distinguishing benign from malignant tumors, gland radiography has a low efficacy rate because morphological overlap in images prevents accurate diagnosis (13). Meanwhile, Histopathology must be used to confirm the final diagnosis, which is the golden standard for benign-malignant differentiation(14). Medical diagnostic Ultrasound has numerous characteristics that contribute to its universal popularity and is considered an effective imaging modality for diagnosing and monitoring various pathologies in several organs. (15); Additionally, Ultrasound is non-invasive anatomical structure scanning; it is safe and inexpensive (16, 17). Sonography helps to clarify clinically equivocal swellings of the salivary glands. Ultrasound has a high rate of salivary stone detection and differentiating between inflammation and neoplasm; moreover, Ultrasound value is up to >90% of cases presenting with inflammatory and obstructive salivary gland diseases; its primary goal is to rule out sialolithiasis or other ductal obstruction. Preoperative preliminary diagnosis of major salivary gland diseases relies heavily on imaging investigations because they provide information about the Tumor's precise position inside the gland and connections to neighboring tissues (18). The distinction between benign and malignant tumors before operation and knowledge of the histological distribution of tumors is crucial for surgical planning. Furthermore, no sonographic feature has satisfactory sensitivity and specificity for predicting the disease entity. As a result, Reasons exist for using a combination of sonographic features to predict serious conditions of the salivary glands (14, 19). Tumors of the glands can be located, measured, and evaluated for internal echogenicity using Ultrasound. Salivary gland tumors can be analyzed for their shape, border clarity, echogenicity status, as well as posterior echo enhancement with Ultrasound, and their blood flow signal can be visualized using color Doppler imaging (20). The majority of studies on salivary gland pathology focus on individual neoplastic diseases, and the vast majority of studies on salivary gland pathology analyze the prevalence of malignant lesions, so this study aimed to evaluate the sonographic difference between benign and malignant tumors and inflammatory disorders and the epidemiology of various types of salivary gland pathologies conclusively.

Methodology

Ninety patients of both sexes with enlarged major salivary glands participated in this cross-sectional study. Maxillofacial specialists examine the clinic pathological features of the patients, and radiology specialists did ultrasonic examinations from December 2021 to August 2022 in the major teaching hospital in Baghdad “Baghdad Medical City, hospital of surgical specialties, maxillofacial Department." The patients with swelling in the parotid or

submandibular salivary glands were considered. The inclusion criteria for this study do not include cases with sublingual gland diseases, autoimmune disorders affecting the salivary gland (such as Sjögren's syndrome and sarcoidosis), or developmental anomalies (such as agenesis, aplasia, and a stafne bone cyst). The U.S. machine used in the examination was the Philips HD11XE Ultrasound machine. The patient was supine, with the head tilted toward the opposite side of the gland being checked and the neck hyperextended. Conventional U.S. Sagittal and cross-sectional scanning was used to generate comprehensive pictures of the lesions with the surrounding tissues in the submandibular and parotid glands; all sonograms were taken with a 7-15 MHz.high-frequency linear array probe. In order to demonstrate the distinctive features of the tumor, the contrast mode was used, and a specific region was chosen. The high-frequency transducer was adjusted, The physician advised the patient to relax, and Ultrasound used a serial scanning technique to identify the location and size of the Lesion in case of a focal lesion figure (1), border as in figure (2), shape figure (3), internal echogenicity figure(4), Calcification in the Lesion, duct dilation figure(5), duct calcifications figure (6) , and if there were any lymphadenopathy in the examined area. Then, the Color Doppler mode was turned on to detect the Lesion's distribution and the predominance of vascularity.

Result

The results of the study assess under the application of the statistical package (SPSS) ver. (22.0), a p-value of less than 0.05 was considered statistically significant; Table (1) displays the histopathological examination results, which showed that 18 tumors patients of 62 tumors were in histopathological examination malignant and the remaining 44 were benign. 68.2% of benign tumors were pleomorphic adenomas, with a p-value of 0.000 on binominal one sample Kolmogorov-Smirnov 0.571. In the cancerous neoplasms, the patients concentrated on mucoepidermoid carcinoma for 61.1% compared to the other types of Kolmogorov-Smirnov (K.S.) = 0.4680, while the inflammatory group showed a highly significant result for sialolithiasis. Patients with malignant tumors have a significantly higher mean age (49.99± 15.65) compared to those with benign tumors (39.45± 13.65), whereas those with inflammatory tumors have a significantly lower mean age (39.45± 15.65). The results of the same statistical analysis are shown in Table (2), and all of the ultrasonic characteristics and their statistical significance are shown in Table (3) in addition to that table (4) represent the Receiver Operating Characteristic for Studied parameters amongst Objectives Groups (benign and malignant**)** according to the ROC results, it could be concluded that cases of present "Calcification in Lesion" in the "Malignant" group are more than those recorded in the "Benign" group. Cases with "Heterogeneity" in the "Malignant" group are more than those recorded in the "Benign" group, then cases with "Hyperechoic & Mixed Echogenicity" in the "Malignant" group are more than those recorded in the "Benign" group. The negative of "Posterior Echo Enhancement" in the "Malignant" group are more than recorded in the "Benign" group. Finally, centre cases of the "Vascularity of Lesion" marker in the "Malignant" group are more than those recorded in the "Benign" group. Figure (7) represents graphically ROC curve plots for the studied categories scored parameters in objectives groups.

Discussion

Sonography helps detect salivary gland swellings as benign or malignant before surgery. Sonography explains clinically confusing salivary gland enlargements. Moreover, accurately detects salivary gland stones and distinguishes neoplastic from non-neoplastic (21). Recent studies have shown that the tumor's precise location inside the gland and its relationship to neighboring structures can only be determined through imaging examinations, making them crucial for preoperative differential diagnosis in addition to posterior echo enhancement, Echotexture, morphology, Calcification

inside the focal Lesion, border clarity, and lymphadenopathy help to differentiate malignant from benign salivary gland tumors(22). The researchers emphasized that no single sonographic characteristic reliably predicts disease exists, so arguments exist for weighing multiple sonographic characteristics to identify benign and malignant major salivary gland tumors and other inflammatory conditions. (23) Understanding salivary gland tumor histological subtype and population distribution is essential for diagnosing this heterogeneous group of gland diseases and improving diagnosis. Future research could benefit global tumor databases (24). In this article, the average age of benign tumors in the current study was 39.91 ± 13.66, similar to other research, which is an important factor in salivary gland tumor (SGT) incidence; Malignant SGTs are more common in older people than benign individuals. These findings corroborate other studies demonstrating an elevated Malignancy risk among the elderly patients (25, 26). Inflammatory salivary gland diseases occur between 20 and 40 years, younger than the average age for malignant tumors, and several factors predispose metabolism intensity at this age. Ulfata et al. 2023 confirmed that inflammatory disorders affect younger people than neoplastic diseases (27, 28). Kadhim et al. and Pouloudi et al. also found females experiencing an elevation in the "Malignant" group. (29, 30) which is in line with previous research showing a modest predominance of females in malignant that is consistent with various studies that found a slight female predominance among malignant salivary gland neoplasm. The current study also shows that cancer affects Middle Eastern women more than men (31, 32). Inflammatory cases had more male patients than the other two groups because sialolithiasis cause more than half of the inflammatory cases in this study are caused by sialolithiasis, which affects males more than females (33). The histopathological examination of neoplastic cases found that Pleomorphic adenoma is the most common benign salivary tumor, followed by Warthin tumor (34). Mucoepidermoid carcinoma is the most common malignant Tumor, followed by acinic and adenoid cystic carcinoma. Previous studies indicate the exact distribution of the histological subtype (34, 35). In inflammatory cases, Sialolithiasis is among the most prevalent conditions affecting the salivary glands. Sialolithiasis is commonly found in major salivary glands; the submandibular gland is the most prevalent site for sialolithiasis, accounting for about 85% of cases; these results are consistent with the present study's findings because the saliva produced by the submandibular gland, which is thicker viscous mucin composition of saliva, richer in phosphorous, calcium, and has high pH levels that are favorable to sialolith formation and due to the curving and elongated nature of the submandibular gland's main duct (36). In this research, the swelling gland among studied groups when comparing the neoplastic group to the inflammatory group at $P<0.01$ since the majority of salivary gland tumors are located in the parotid gland (34), most of which (75.0–80.0%) are benign. (37), Non-neoplastic conditions most often involve the submandibular gland (6).this study found that 50% of inflammatory cases were caused by sialolithiasis, which forms in the submandibular gland in 85% of cases. Such obstructions frequently end with sialadenitis, a bacterial infection of the salivary glands that can contribute to abscess formation (38). According to David et al., the sonographic evaluation of the patients found that regional lymphadenopathies are uncommon in primary tumors of the salivary glands. Even though the current study outcome showed that no significant relationships accounted in the distribution but the odds ratio was approximately two times higher in the malignant group when compared to studies published in the literature showing that pathologic cervical lymphadenopathy and extra-glandular distribution can be noticed , and diagnosed, Lymphadenopathy was more common in malignant tumors (39, 40).The result was insignificant when comparing lymph node enlargement in the neoplastic group with an inflammatory group because unilateral upper cervical lymphadenopathy

frequently accompanies salivary gland inflammation. And the lymph nodes become enlarged and tender (18, 41). The shape of focal salivary gland neoplasms, El-Khateeb et al. found that tumors with an irregular shape are more likely to be malignant. This was especially important for determining lesion form. In addition, most benign tumors are pleomorphic adenomas, which explains why lobulated tumors are the most commonly reported benign morphology. Multiple investigations, including the current one, found that lobular (43.2%) and oval (31.8%) shapes predominate among benign tumors (42). Although the lobulated form is an interesting and useful feature, which appears in barely fifty percent of cases of pleomorphic adenomas and just a few malignant tumors (43). Malignant tumors had three times more irregular forms than benign ones. Kim believes tumors acquire irregular shapes due to invading surrounding structures. (44) Guiban et al. confirm this conclusion and links it to malignant neoplasm's aggressive behavior and infiltration into nearby structures (45). When all the study cases were compared, the result was highly significant between the subjective group and the inflammatory group round shape predominance 82.1 because of the diffusely enlarged inflamed gland and edema and fluid Congestion inside the inflamed gland (18, 46). Malignant salivary gland tumors have unclear margins, but benign ones are well-defined (22, 23). In this study, the odd ratio of the irregular border increased approximately fourfold in malignant tissue compared to benign tissue, indicating a relevant association. Malignant tumors have partial incomplete capsules or missing all, causing the indistinct border (20). Malignant tumors smaller than 2 centimeters in diameter, particularly low-grade malignant, are frequently misdiagnosed by imaging as benign and usually presented with smooth sharp, distinct borders and a uniform structure. Larger lesions have irregular margins and heterogeneous echo structures. These tumors are most often diagnosed as malignant tumors by Ultrasound (19).

When compared to the normal gland tissue, the Lesion's internal echo was hypoechoic or mixed. No complete isoechoic or hyperechoic lesions were detected in benign or malignant lesions in this study. In this research, 90.9 percent of benign and 42.9 percent of inflammatory lesions were hypoechoic. Acute inflammation and obstruction sialadenitis increase gland tissue hypoechoic changes. Odema makes the parenchyma hypoechoic and spongy. (47)Sometimes, Hyperechoic internal reflexes present in 7.1% of gland parenchyma in the inflammatory group can be signs of air-producing microbes. (48), Moreover, Due to abscess formation, the gland becomes heterogeneous in the final stage, and Calcified sialolith is readily visible on Ultrasound (41). Moreover, in focal swelling, Malignant neoplasms had an eight-fold increase in mixed echotexture compared to benign neoplasms. The lesions analyzed here were heterogeneous (different internal echo), possibly due to necrotic and hemorrhagic tumor regions (49, 50).

The above-described data supports a conclusion about echogenicity consistent with other studies in the field. (23, 51, 52)

Sonographic evidence of Calcification or microcalcifications in lesions was significantly significant at $P<0.01$ for subjective neoplastic groupings. Wu et al. consider Calcification as one of among the most crucial sonographic characteristics for distinguishing malignant from benign salivary gland lesions. The odds ratio for Calcification in focal lesions was 5.6 greater in the cancerous salivary neoplasms than in the benign neoplasms group. As Bravle et al. proposed, the mechanisms to explain intratumoral Calcification in the salivary gland because of either metastatic Calcification inside the tumor or hypercalcemia or may be due to dystrophic Calcification in necrotic areas, as well as calcinations of the material secreted by neoplastic cells (23, 53, 54).

Echotexture, heterogeneous or homogenous. 50% of inflammatory cases, especially chronic sialadenitis, had heterogeneous parenchyma Due to fibrous changes (hyperechoic) and fatty degeneration (hypoechoic) (18, 55).

"Heterogeneity Status" occurrence in malignancy is associated with a 3.4 heterogeneous echotexture of the tumor authors concludes that more aggressive malignant neoplasms have a more characteristically heterogeneous status than benign tumors. This study's results confirm previous findings(56). Due to underlying cystic degeneration or dystrophic Calcification, persistent lesions may appear inhomogeneous (19).

According to Goncalves et al., Ultrasound helps 90% of obstructive inflammatory disease patients. In 95% of false-negative sialolithiasis cases, duct dilatation occurred. Stimulating gland secretion with ascorbic acid can cause duct dilatation. After this modification, sialolithiasis may become visible (18, 57, 58).

Salivary gland inflammation and obstruction disease as a percentage is rising and accounts for approximately 30 percent of all salivary gland diseases (18).

In this research, all cases of stones are associated with duct dilatation. Calculi 3 mm and bigger may typically be seen; however. A low amount of stone mineralization may bring on these false negative findings (59).

On color Doppler examination of the focal neoplasm, the vascularization pattern was categorized based on whether the major vessel development was found in the tumors centers or their peripheries (60).

Benign salivary Tumors are poorly or predominantly peripherally vascularized with no central flow; occasionally, depending on size because pleomorphic adenoma is the most commonly reported benign Tumor in this study; the core vasculature of pleomorphic adenomas is reduced. (39, 52). Hypervascularization due to inflammation visible on color Doppler is highly significant and primarily caused by edema and increased vascularity of hypoechoic parenchyma (18).

Conclusion

Pleomorphic adenoma is the most prevalent benign Tumor of the salivary gland, and mucoepidermoid carcinoma is the most common malignant one. Malignant tumors showed a more irregular shape, heterogenous; malignant tumors showed more central vascularity and no posterior acoustic enhancement. Malignancies have lesion calcifications and affect females more than males. Benign tumors have oval, lobulated, hypoechoic, homogeneous, well-defined borders, no penetration into surrounding tissues, primarily peripheral vascularity, and with the presence of posterior echo enhancement. Sialolithiasis appears hyperechoic and causes inflammation in salivary gland tissue, which appears hypoechoic, and inhomogeneous with enhanced vascularity and duct dilatation.

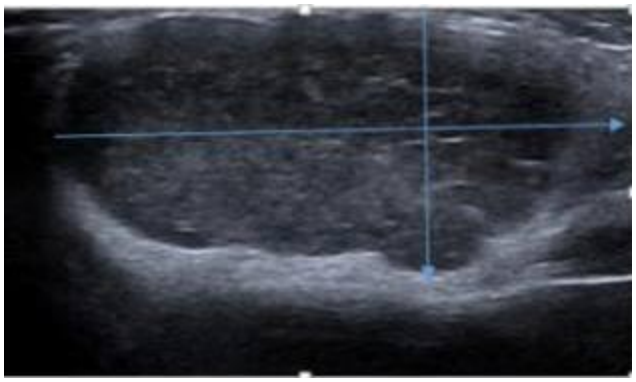


Figure (1) ultrasound image of the size of focal lesion in parotid gland Grayscale measure (19x10 mm)

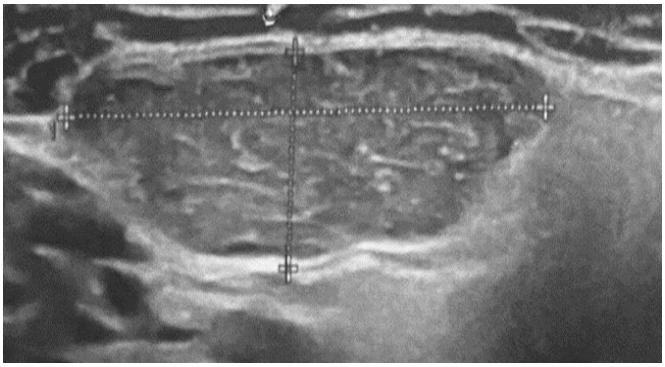


Figure (2) Gray scale image of well define submandibular focal gland lesion

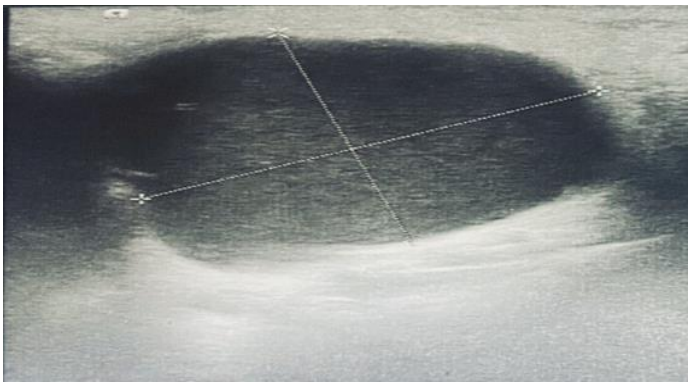


Figure (3): Grayscale U.S. image of oval shape focal lesion

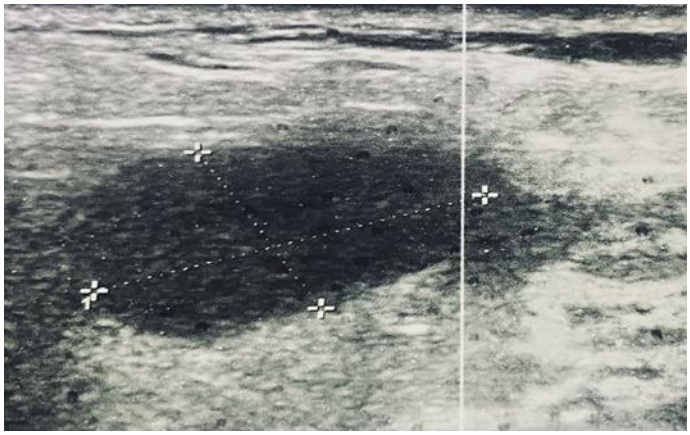


Figure (4) gray scale U.S. image of hypoechoic homogenous internal echogenicity focal parotid lesion

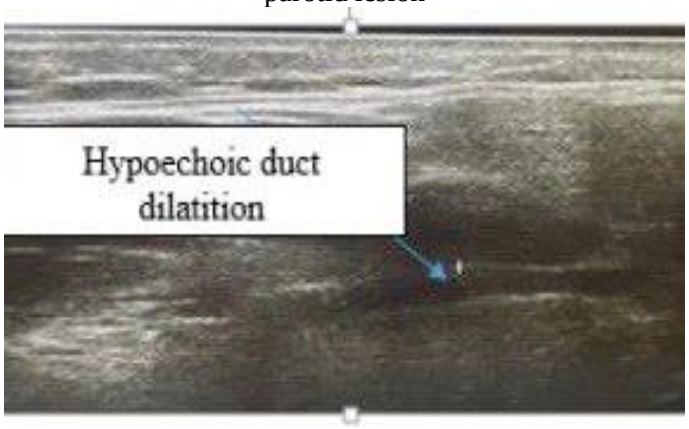


Figure (5) Dilated submandibular gland duct

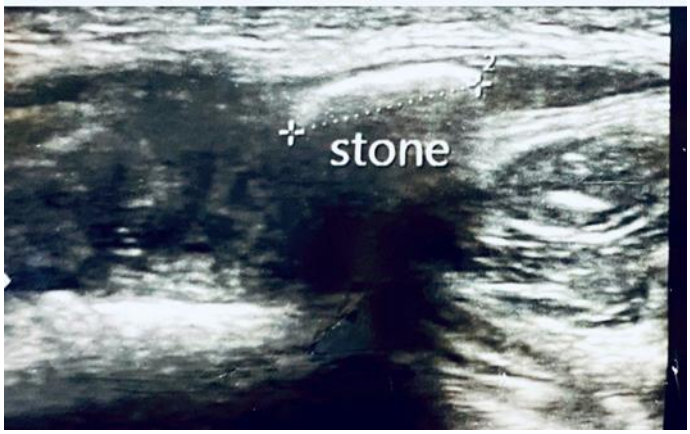
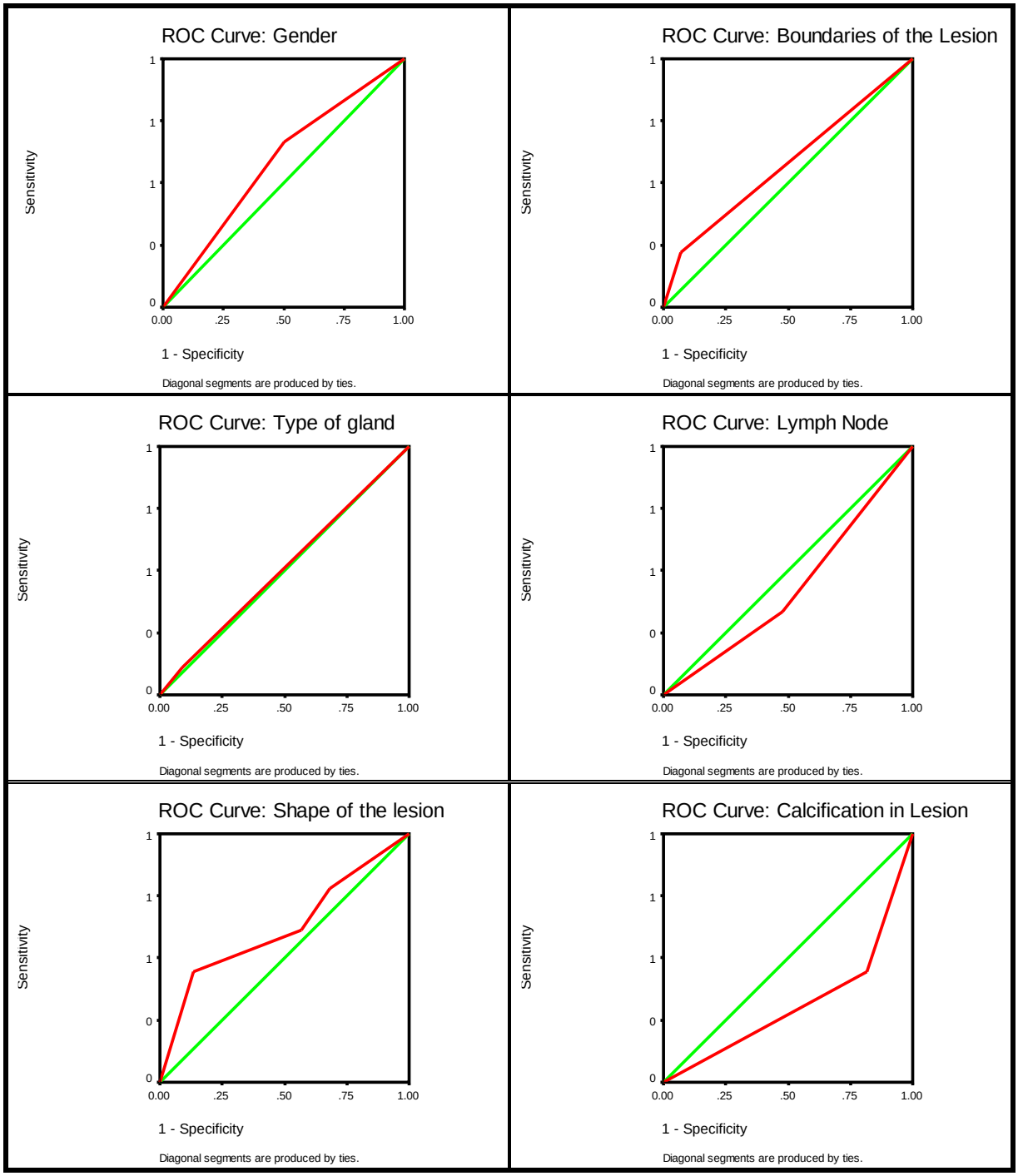


Figure (6) stone in ultrasound. Grayscale U.S. hyperechoic linear calcification inside the dilated Stenson duct


ROC Curve: Gender
Sensitivity
1 - Specificity
0.00 .25 .50 .75 1.00
Diagonal segments are produced by ties.
ROC Curve: Boundaries of the Lesion
Sensitivity
1 - Specificity
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Diagonal segments are produced by ties.
ROC Curve: Type of gland
Sensitivity
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Diagonal segments are produced by ties.
ROC Curve: Lymph Node
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Diagonal segments are produced by ties.
ROC Curve: Shape of the lesion
Sensitivity
1 - Specificity
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Diagonal segments are produced by ties.
ROC Curve: Calcification in Lesion
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Diagonal segments are produced by ties.

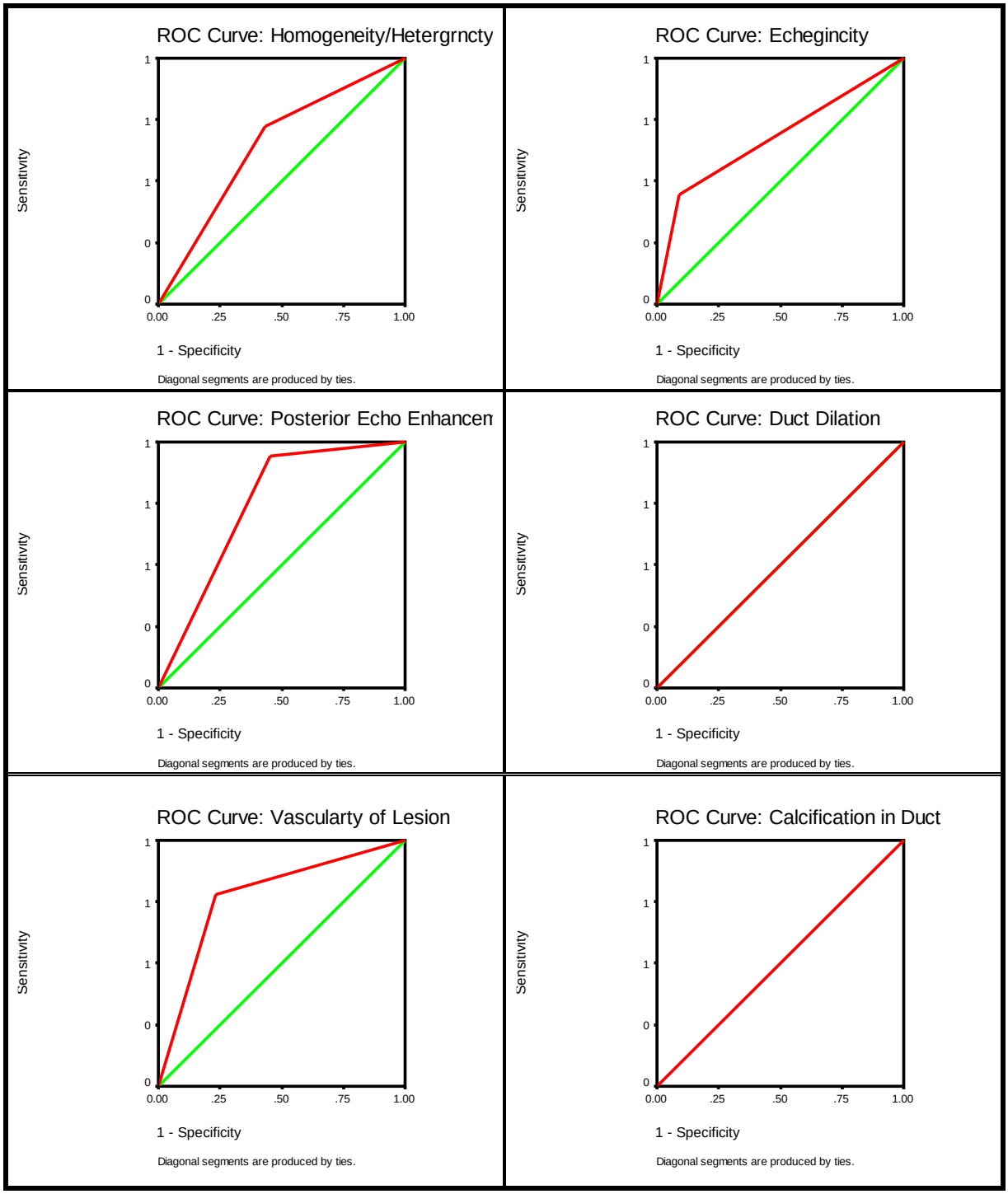

Figure (7) ROC-Curve plots for studied Categories Scored parameters Amongst Objectives Groups (benign and malignant)

Table (1): types of cases that appear in this study and their statistically significant Testing

Groups of the study	Histologically diagnosed cases	No.	%	C.S. (*) P value
Benign Tumors	Pleomorphic Adenoma(P.A)	30	68.2	KS= 0.571 P=0.000 H.S.
	Sialolipoma	2	4.5	
	Basal cell Adenoma	3	6.8	
	Pleomorphic Adenoma Recurrent form	4	9.1	
	Warthin Tumor(W.T)	4	9.1	
	oncocytoma	1	2.3	
Malignant	Acinic cell Carcinoma(ACC)	3	16.8	KS= 0.468 P=0.000 H.S.
	Mucoepidermoid Carcinoma(MEC)	11	61.1	
	Adenoid Cystic Carcinoma(AdCC)	2	11.2	
	carcinoma ex-pleomorphic adenoma (CEPA)	1	5.6	
	Metastasizing pleomorphic adenoma (MPA)	1	5.6	
Inflammatory	Sialolithiasis	14	50	KS= 0.452 P=0.000 H.S.
	Tuberculosis of Parotid	1	3.6	
	Benign reactive intraparotid Lymph Node	2	7.1	
	Vescella Zoster Sialodenitis	1	3.6	
	Acute Sialodenitis	10	35.7	

(*) H.S.: Highly Significant. At P- value <0.01; NS: Non-Significant. At P-value >0.05

Table (2): Distribution of Socio-Demographical Characteristics variables for the studied subjects with testing significantly

SDCv.	Groups	Benign Tumors		Malignant		Inflammatory		C.S. (*) P-value
	Classes	No.	%	No.	%	No.	%	
Gender	Male	22	50.0	6	33.3	22	78.6	CC= 0.318 P=0.000 HS
	Female	22	50.0	12	66.7	6	21.4	
	Total	44	100	18	100	28	100	
Age Groups Years	< 20	3	6.8	0	0.00	4	14.3	CC= 0.446 P=0.013 S
	20 _	5	11.4	0	0.00	1	3.6	
	30 _	11	25.0	7	38.9	7	25.0	
	40 _	13	29.5	2	11.1	9	32.1	
	50 _	11	25.0	3	16.7	5	17.9	
	≥ 60	1	2.3	6	33.3	2	7.1	
	Mean ± SD	39.91 ± 13.66		49.94 ± 15.98		39.45 ± 15.65		
	Total	44	100	18	100	28	100	
C.S. Between {Age Groups & Gender}(*)		CC 0.354 P value 0.278 N.S.		CC 0.439 P value 0.232 N.S.		CC 0.548 P value 0.034 S		-

Table (3) Ultrasound imaging Parameters comparison among the various groups with Testing significantly

Sonographic Parameters	Classes	Benign neoplasm		Malignant neoplasm		Inflammatory		P-value Benign neoplasm x Malignant neoplasm	P-value All Groups
		No.	%	No.	%	No.	%		
Site of Lesion	Right(R)	23	52.3	12	66.7	15	53.6	CC 0.131 P value 0.299 NS odd ratio 1.825 (lift: Right)	CC= 0.112 P=0.566 NS
	Left(L)	21	47.7	6	33.3	13	46.4		
Type of Gland	Parotid	40	90.9	16	88.9	16	57.1	CC 0.031 P value 0.807 NS: Odd ratio 1.250 (P:S)	CC= 0.359 P=0.001 H.S.
	Sub mandibular	4	9.1	2	11.1	12	42.9		
Lymph Node	Present	23	52.3	12	66.7	18	64.3	CC 0.131 P value 0.299 NS: Odd ratio 1.825 (A:P)	CC 0.131 P value 0.453 NS
	Absent	21	47.7	6	33.3	10	35.7		
The shape of the Lesion	Negative	0	0.00	0	0.00	23	82.1	CC 0.349 P value 0.035 S	CC 0.691 P value 0.000 H.S.
	Oval	14	31.8	4	22.2	4	14.3		
	Round	5	11.4	3	16.7	23	82.1		
	Lobular	19	43.2	3	16.7	1	3.6		
	Irregular	6	13.6	8	44.4	0	0.00		
Calcification in Lesion	Present	8	18.2	10	55.6	0	0.00	CC 0.350 P value 0.003 HS O ratio 5.618 (A:P)	CC 0.730 P value 0.000 HS
	Absent	36	81.8	8	44.4	28	100		
Homogeneity Status	Present	25	56.8	5	27.8	0	0.00	CC= 0.255 P=0.038 H.S. Odd ratio=3.421 (H.O.:HE)	CC 0.730 P value 0.000 H.S.
	Absent	19	43.2	13	72.2	28	100		
Echogenicity	Negative	0	0.00	0	0.00	11	39.3	CC 0.376 P-value 0.001 H.S. Odd ratio 8.000 (H.Y.:MX)	CC= 0.580 P=0.000 H.S.
	Hyperechoic	0	0.00	0	0.00	2	7.1		
	Hypoecho (H.Y.)	40	90.9	10	55.6	12	42.9		
	Mixed(Mx)	4	9.1	8	44.4	3	10.7		
Posterior Echo Enhancement	Positive	24	54.5	1	5.6	0	0.00	CC 0.413 P value 0.000 HS. Odd ratio 20.000 (Pos.: Neg.)	CC 0.506 P value 0.000 H.S.
	Negative	20	45.5	17	94.4	28	100		
Duct Dilation	Positive	0	0.00	0	0.00	14	50	CC 0.000 P value =1.000 NS	CC= 0.538 P value 0.000 HS
	Negative	44	100	18	100	14	50		
Calcification in Duct	Positive	0	0.00	0	0.00	14	50	CC 0.000 P value 1.000 NS	CC 0.531 P value 0.000 HS
	Negative	44	100	18	100	14	50		
Vascularity of the focal Lesion	Negative	1	2.3	0	0	28	100	CC 0.457 P value 0.000	CC= 0.744 P=0.000
	Peripheral	33	75	4	22.2	0	0.00		

	(p)							HS	H.S.
	Centre(c)	10	22.7	14	77.8	0	0.00	OR=11.550 (P.: C.)	
Vascularity of Gland	Normal	44	100	18	100	11	39.3	CC 0.000 P value 1.000 NS	CC 0.583 P value 0.000 H.S.
	Increased	0	0.00	0	0.00	19	60.7		
Boundaries of the Lesion	Well Define	41	93.2	14	77.8	11	39.3	CC= 0.216 P=0.082 NS: OR=3.905 (W.D.: I.D.)	CC= 0.583 P=0.000 H.S.

Table: (4): Receiver Operating Characteristic for Studied parameters amongst benign and malignant

Test Result Variable	Senstivity.	Specifity.	Area	Std. Error	Asy. Sig.	Asymp. 95% C.I.	
						L.b.	U.b.
sex	0.667	0.500	0.583	0.079	0.306	0.428	0.739
Site of Lesion	0.333	0.523	0.428	0.080	0.377	0.272	0.584
Type of Gland	0.111	0.909	0.510	0.082	0.901	0.350	0.671
Lymph Node	0.333	0.523	0.428	0.080	0.377	0.272	0.584
The Shape of the Lesion	0.611	0.432	0.620	0.085	0.141	0.454	0.786
Calcification in Lesion	0.444	0.182	0.313	0.079	0.022	0.158	0.468
Homogeneity/Heterogeneity	0.722	0.568	0.645	0.076	0.075	0.496	0.795
Echogenicity	0.444	0.909	0.677	0.082	0.030	0.516	0.837
Posterior Echo-Enhancement	0.944	0.545	0.745	0.063	0.003	0.621	0.868
Duct Dilation	0.000	1.000	0.500	0.081	1.000	0.340	0.660
Calcification in Duct	0.000	1.000	0.500	0.081	1.000	0.340	0.660
Vascularity of focal Lesion	0.778	0.767	0.773	0.068	0.001	0.639	0.906
Boundaries of the focal Lesion	0.222	0.932	0.577	0.084	0.344	0.412	0.742

Null hypothesis: true Area = 0.5

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