REVIEW ARTICLE

RADIOLOGIC IMAGING FEATURES OF MAJOR SALIVARY GLANDS: A REVIEW

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ABSTRACT

The predominant salivary glands are parotid, submandibular, and sublingual glands. Innumerous small salivary glands are present in the buccal cavity, pharynx, and the larynx, which are not identified on usual radiologic studies. Frequently used radiology imaging comprise of plain radiography and conventional sialography. Nowadays, high-resolution ultrasonography (HRUS) is being progressively used for the salivary gland imaging. Hence, the significance of cross-sectional studies like computed tomography (CT) and magnetic resonance imaging (MRI) have transformed the imaging of the salivary glands. Different changes in radiologic studies have led to increase sensitivity in the detection of disorders that include the significant salivary glands. Ultrasonography, plain radiographs, sialogram, magnetic resonance imaging (MRI), computed tomography (CT), and nuclear scintigraphy /positron emission tomography (PET) all considered as involving in the programming of future treatment, surgical or otherwise. We reevaluate the techniques applied for the chief salivary glands imaging, and its application. An exploration of literature search was determined utilizing the electronic databases of Pub Med, Google scholar, Elsevier from 1970 to 2015 for English-language articles. The search terms utilized were salivary gland imaging. The titles and abstract of articles were evaluated. Entire text and reviews were appraised when the abstracts meet to the inclusion criterion. This review included all articles that were used for the advancement of information about salivary gland imaging.

KEY WORDS: Salivary glands; Parotid, Submandibular, Sublingual glands

INTRODUCTION

Saliva is produced from exocrine salivary glands. The paired three important glands are submandibular, parotid and sublingual glands and many less significant smaller glands distributed all through the buccal cavity, the nasopharyngeal region and tracheobronchial region. [1] .A conclusive imaging played a major role as a diagnostic and therapeutic tool in different medical zones. It could be valuable in identifying various orofacial swellings, such as inflammatory swellings due to dental or skin infections. Determination is acquired with the use of many leading imaging modalities nowadays. They include sonography, computed tomography, magnetic resonance and radionuclide imaging. Despite the fact, that computed tomography (CT) scan and magnetic resonance imaging (MRI) are worthwhile imaging methods but are highly priced and not widely accessible. An optional diagnostic modality is ultrasonography, which is broadly approachable, comparatively economical and non-aggressive. [2] Ultrasound is globally recognizable as the prime diagnostic aid for evaluation of lymph nodes and soft-tissue diseases of major salivary glands. [3, 4] Multiple disorders influenced the salivary glands, are systemic, obstructive, inflammatory and malignant. Color Doppler can support the ultrasound by delineating the vascular flow in the lesion.[1]

DISCUSSION

Sialosis

Sialosis, refered to non neoplastic diffuse and non-inflammatory condition of tne major salivary glands most commonly parotids. It is uncommon but recurrent disease it has multifactor causes and is usually not correlated with any autoimmune illness like sarcoidosis and Sjogren's syndrome, hence the symptomatic presentations are same. The etiology of sialosis includes alcoholism, bulimia, achalasia, diabetes mellitus, hyperlipidemia, obesity and malnutrition (avitaminoses). The usage of medicines such as diuretics, thiourea and iodinated contrast media can cause sialosis. Clinically presented with glandularen largement bilaterally without inflammation and slow development. Patient's clinical history, ultrasound and perhaps the biopsy of the parotid gland can be helpful. Ultrasound S exhibit hyperechoic texture and increase size of salivary glands with a badly visualized deeper lobe, however, no specific areas or raised vascularity identified. [5, 6]

Acute Inflammation

The most common cause of acute inflammation is Mumps virus, It manisfest as rounded, hypoechoic lesion with increase vascularization on color Doppler ultrasound. Ultrasound is usually done to differentiate between normal glandular parenchyma and necrotic abscess. Bacterial infection are most commonly due to Staphylococcus aureus or oral flora.[7]Acute inflammatory conditions without abscess shows enlarged salivary glands with uniform texture They may exhibit inhomogeneous; numerous oval, small hypoechoic lesions; with increased blood flow. Lymph nodes were enlarged having raised blood flow in center.[4]

Abscess Formation

Acute inflammation generally progress into abscess, with characterization of liquid or semiliquid components and often end up in fistula formation, either towards the surface or to the deep layers of the gland.[8] Stimulating elements comprises of dehydration and excretory duct blockage due to calculus or fibrosis. [4] Abscess in the parotid gland, in few cases, can be a lethal disease, as it can disseminate to the head and neck.[8]Tuberculosis involving

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a parotid gland is an un common clinical presentation.[9,10] Manifestation of tubercular abscess, is an enlarged parotid gland with a focal area, with pseudo-solid, inhomogeneous texture and proper regular margins (caseous necrosis). [11]

Chronic Sialadenitis

Chronic inflammatory disorders in the parotid gland were noticed as hypoechoic lesions having in homogenous internal echoes. Edges were uniform with flecks of calcification. Vascularity and prominent ducts were not recognized. Presence of calcifications in the gland indicates that calcifications are frequent in well-established chronic inflammatory conditions.[12]Chronic Sialadenitis represents the periodical enlargement of the gland, sometimes with pain and could or could not be related to the meal. Gland is normal or small, and usually does not show great vascularity. [13, 14]

Chronic Sclerosing Sialadenitis (Kuttner Tumor)

Kuttner tumor referred to chronic sclerosing inflammation of salivary gland .it is non neoplastic condition but it produce a firm swelling of gland and may mimic neoplasm. It diffusely involve the salivary gland (mainly the submandibular gland), having several tiny hypoechoic regions interspersed on a heterogeneous ground of salivary parenchyma. Some focal areas are featured as a hypoechoic heterogeneous lesion in a normal gland.[15, 16]In all unconfirmed situation, validation with the fine-needle aspiration biopsy is advocated.[17, 18]

Granulomatous Sialadenitis

Granulomatous sialadenitis exists very occasionally.[4] it's manifestations as one or numerous hypoechoic foci in a normal or the larger sized gland or represents as diffusely reduced echogenicity. Vascularity may be increased.[18, 19] Mycobacterial diseases may be illustrated as a mass. Chou et al et al. narrated it as regional, intraparotid, anechoic areas which may show a single or multiple cavitary lesions. Necrotic caseous lesions, becomes very hypoechoic, without color flow, juxtapose to the most salivary neoplasms.[20] Actinomycosis may simulate a malignant neoplasm revealed as a hypoechoic focus with poorly demarcated borders. [4]

Sialolithiasis

Ultrasound is a prevalent method in salivary stone diagnostics. Sensitivity for diagnosing stones, is 94%, specificity – 100%, while accuracy is 96% .[21,22,23] Jäger et al., stated US sensi¬tivity for stone diagnosis accounts up to 59.1–93.7%, whereas, specificity is 86.7–100% [24]. Ultrasound is a helpful tool in detecting non-opaque stones possessing sensitivity of 80–96% [25] The characteristics, sonographic picture of a sialolithiasis shows a round or oval shape lesion, echogenic and giving acoustic shadowing .[20,24,14] Salivary duct calculus shows dilatation of the duct superior to obstruction, which may be demonstrated on ultrasonography. [25] Calculus below 2 mm may not show acoustic shadowing.[20, 23, 25] Diagnostic flaws can occur in a very tiny calculus present in intraparenchymal ducts, without duct dilatation. [20, 24] Sialolithiasis is the cause of 42–77% of cases of salivary duct obstruction.[26]

The diagnosis of fine calculi might be supported with sialogogue injection, which shows salivary duct distention and hence enable stone imaging. [20, 24] Tiny stones, in the area of Wharton's duct sinus are problematic to anticipate, however 65% of patients revealed salivary duct distention. Stone nearest to the opening of Wharton's duct or in its medial portion may be better visualized often on Ultrasound after compression with a finger, or from the inside of the mouth. [14] 5o % of the stones represents inflammatory features on ultrasound.

Irrespective of various benefits of ultrasound, it is less valuable in distinguishing a clump of calculi from a single, big calculus. Salivary gland stones are generally present in the submandibular gland (more than 60% of cases) and maybe countless.[4,27] Parotid glands are involved approximately around 10%–20%. [28] On x-rays, intraglandular small calculus could be skipped and approximately 20% sialoliths seen as radiopaque shadow. [29] CT shows large stones but without an exact chance of assessments of the ducts.[30] The main method for visualization of the intraglandular duct and the submandibular ducts is digital sialography.[31] A noninvasive, appropriate procedure is MR sialography, which also provide magnificent details in the identification of sialoliths.[31, 24] Ultrasound is an absolute noninvasive procedure, especially in investigations of clinical doubt of sialolithiasis, and it can be applied as a main technique. [28, 30] Sialoliths which are less than 2–3 mm may be skipped could be due to the lack of acoustic shadowing. Sialolithiasis genesis incomplete or entire causes, a mechanical blockage of the salivary duct which produces repetitive enlargement of a salivary gland, particularly during food and may be superimposed by microbial infections.[32] Sialoliths which is present in the terminal part of the submandibular duct (Wharton duct) feel in the floor of the oral cavity. Nevertheless, sialoliths which is present in the proximate part of the duct and in the tissue of salivary glands may be determined only radiologically. US characteristics of sialolithiasis comprise hyperechoic striated lines with distal acoustic shadows, which indicate calculus. [33]

In clinical symptomatic patients with duct obstruction, distended excretory ducts are obvious. [22] In suspicion of submandibular gland calculus, US may determine the presence of stone in the glandular tissue or either in the Wharton duct.[34] in patients of Chronic ductal sialolithiasis superimposed by chronic or recurrent inflammation and due to this, gland loses its action. At this phase of disease, stones which are present in a non-dilated duct may be hard to determine. Calculi placed near the opening of a duct and in the mid portion of the Wharton duct may occasionally be preferably determined. When extra pressure, is given from an inner part of mouth, while ultrasound analysis. In about 50% of cases, sialolithiasis presents with inflammatory condition.[35]

Sjogren Syndrome

It is a disease of an autoimmune system of chronic nature chiefly influencing females more than 40 years. It is a chronic autoimmune disorder involving mainly the salivary and lacrimal glands and is associated with hyperactivity of the B-lymphocytes and with autoantibody and immune complex production. [36] Considerable symptoms are dry eyes and mouth. The developed form of Sjogren syndrome could be identifiable at ultrasound regarding parotid and submandibular glands.[37] It may involve any salivary glands. The Sonographic presentation of advanced Sjogren syndrome comprised of heterogeneous texture of the glandular tissue with a disseminated numerous small, oval shape, anechoic or hypoechoic foci, mainly well outlined, and a raised parenchymal vascularity.[38,13,39] Hypoechoic or anechoic regions are supposed to be infiltrated by lymphatic cells , damaged salivary tissues and distended ducts.[40] In addition, US examination is needed for prompt diagnosis of likely lymphomatous change in cases with Sjogren syndrome.

Biopsy is advocated for foci more than 2 cm or rapid progressing areas. [41, 42] Differentials of Sjogren syndrome with scattered lymphoma in salivary glands should be cautiously looked. Non-Hodgkin lymphoma featured by as small multiple nodules disseminated with a raised blood flow in the salivary parenchyma.[43,44] Furthermore, bilateral inflammation (acalculous)) granulomatous disease, (e.g. sarcoidosis) hematogenous metastases, and benign lymphoepithelial lesions in HIV-positive cases must be considered valuably in patients of numerous hypoechoic lesions disseminated in salivary tissue parenchyma.[4]

Metastases

Metastases, in salivary glands are the very rare presentation. Main tumors spreading to salivary glands may be placed in the head and neck region .Melanoma, spinocellular malignancy, breast, and pulmonary cancer may exhibit metastasis to intraparotid lymph nodes.[4]

Benign Tumors

Pleomorphic adenoma is the most prevalent malignancy occurring in the salivary tissue superficial part, of the parotid gland possessing 80% of adenomas. There is a female preponderance, and the majority of patients are more than 40 years of age. These are single, oval shape and well marginated possessing a capsule of different thickness. The ultrasound image of the tumor shows well marginated, hypoechoic focus and lobulated borders. Color Doppler sonography mainly represents a modest vascularity. A prominent peripheral flow configuration has been demonstrated.[13] The myxoid component of the focus an exhibited very a hyper intense signal on T2W images on MR study.[45] Many benign tumors in contrast enhanced CT scan images and MR sequences displayed uniform enhancement. Bigger lesions are mainly appeared as heterogeneous appearance, areas of low attenuation and showing necrotic foci, previous hemorrhage, and cystic pattern. Pleomorphic adenoma is mainly slow progressing tumors. In prolonged lesions, malignant conversion is noticeable in 5% of patients. The hyper intense signals on T2W images, is a noticeable indicator of a benign type form of the lesion. They possess sharp defined margins and homogeneous solid appearance. However, cyst generation is usually seen. On ultrasonography they are not homogeneously appear like in cases of the pleomorphic adenomas. The cyst comprises of a homogeneous substance of 10-20 HU on computed tomography. The surrounding contrast enhancement is visualized in cysts. Solid lesions an exhibited the same representation as pleomorphic adenomas on MR images, whereas cystic tumor produce low to ,intermediate or mixed signal intensities on T2W sequences. The mitochondrium-rich oncocytes of Warthin's tumors are the cells that cumulate the 99m Tc pertechnetate on salivary nuclear studies. Warthin's tumor, other benign lesions include lipomas, which are better described on CT because of their particular fat attenuation. On Ultrasonography, lipomas displayed a minimal hypoechoic texture with a straight striated pattern. On MRI studies lipomas are high on T1 with inhibition of the signal on fat saturation images. Rare lesions include dermoid, basal cell adenomas and neurogenic tumors. It is generally very difficult to differentiate to differentiate these disorders from other benign tumors and the diagnosis is made on a histopathological basis.[1, 4]

Malignant Tumors

Mucoepidermoid carcinomas are prevalent malignant tumors of salivary glands (80 %). They could be low or great potential of malignancy. Smaller lesions below 2 cm size are homogeneously seen and possess properly demarcated borders and might be tough to discriminate between benign lesions. Big size, having Irregular walls and necrotic areas support a high-degree of malignancy. Ultrasound truly discriminate a low form from an extensive tumor in many patients. Difficulty noticed when the lesions are very larger in size, where ultrasonography unable to demarcate the whole extension of the lesions. On CT scan, low-degree tumors are benign with properly outlined, smooth borders. Cystic foci may be seen, with a less attenuation of value of 10 to 18 HU. Hardly, focal calcific areas may be visualized. The aspect is same to a benign pleomorphic tumor. With the greater form of malignancies, the increase cellularity identified and thus the T2signal diminish. Hence low to the intermediate signal is a characteristic of great-form of malignancy on MR studies. Adenoid cystic tumor is a slow going, extensive penetrating tumor and propensity for perineural invasion. The prime line of modality of choice is ultrasound and should be incorporate with the needle biopsy if practicable. CT is helpful, besides determining the attenuation of the lesion, in diagnosing of calculi and bones. MR, due to its excellent soft tissue contrast enhancements, is the better diagnostic tool.1 The manifestation of metastatic lymph nodes in addition to neoplasm in the salivary gland vigorously indicate a malignant nature.[1, 4]

CYST

Ultrasonography reveals a well-defined lesion with imperceptible walls, anechoic center, and posterior acoustic enhancement. [4] There is no internal vascularity on power Doppler or with color Doppler. On computed tomography, cystic lesions appear as well circumscribed, non-enhancing (following contrast administration), and low density areas. [46] They appear as well circumscribed, high signal areas on T2-weighted MRI. No enhancement is seen, following the administration of gadolinium contrast, unlike benign mixed tumors. Sialography permits only indirect visualization of the cyst, evaluated by the displacement of the ducts around them.[47]

Post Radiation

The significant salivary glands are mainly irradiated during radiotherapy of malignancies of the head and neck. The noticeable harmful reaction of such treatment is xerostomia due to functional and structural impairment of salivary tissue.[48] Although there is still a lack of a standardized method for the assessment, morphological assessment methods (i.e. histological evaluation, CT, MRI and ultrasonography) and functional assessment methods (i.e. sialometry, MR sialography and scintigraphy) can be used together for a more accurate assessment of the post-radiotherapy salivary gland.[49]

CONCLUSION

A variety of disease patterns involve the major salivary glands with few characteristic features on imaging. High resolution ultrasound should be the initial screening imaging a diagnostic tool followed by sialography, if needed. CT is the backbone of imaging in sialolithiasis while MRI is more perfect for neoplastic methods with associated invasion.

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