US and Elastography of the Salivary Glands

Hasan YERLI, MD

Baskent University Zubeyde Hanim, Practice and Research Center, Department of Radiology
Disclosures

• Nothing to disclose related to this presentation
Educational objectives

- Define the importance of US method
- Present the features of common and uncommon major salivary gland lesions
- Define the place of sonoelastography (SE) in the management of the salivary gland lesions
- Present correlative imaging findings with CT and MRI approach
Salivary glands

Major

• Parotid
• Submandibular
• Sublingual

Minor

• 600-1000 aggregations of glandular tissue
Parotid gland

Normal salivary gland parenchyma seems homogeneously hyperechoic
Submandibular gland
Sublingual gland
METHODS

- B-mode Sonography
- Color Doppler Sonography
- Spectral Doppler Sonography
- Dynamic CEUS
- US-guided FNAB
- Sonoelastography
- CT
- MRI \{ with Dynamic CE \}
- Diffusion-weighted imaging
- Sialography (DSA, MR-sialo)
- Scintigraphy
US approach to salivary gland lesions

• Echogenicity
• Location
• Border
• Vascularity
• Size
• Shape
• Presence of cystic areas
• Distal enhancement
DIFFERENTIAL DIAGNOSIS FOR SALIVARY GLANDS LESIONS

- **Congenital diseases**: Branchial cleft cyst, agenesis, ektopy

- **Sialolithiasis**

- **Inflammatory diseases**: Acute sialadenitis: Viral (mumps), bacterium (Staf. Aureus)
  - Juvenile recurrent parotidit, radiation sialadenitis
  - Chronic sialadenitis:
    - Granulomatous: Tbc, sarcoidosis, Kimura dis., Wegener
  - Autoimmune: Sjogren

- **Tumors**
  - Benign: Pleomorphic adenoma
  - Warthin tumor
  - Lipoma
  - Basal cell adenoma
  - Myoepithelioma
  - Canalicular adenoma
  - Oncocytoma
  - Nörofibroma
  - Hemangioma
  - Lymphangioma
  - Angiolipoma

  - Malign: Carcinomas: Mucoepidermoid, adenoid cystic, adeno, acinic cell
  - squamous cell, basal cell adeno, Myoepithelial, duktal

  - Other: metastatic, lymphoma, leukemia, sarcoma
LYMPH NODES

Parotid contains lymph nodes
Nineteen years old woman with neck lump

at the rest position

with Valsalva maneuver
at the rest position

with Valsalva maneuver
Unilateral Submandibular Gland Agenesis associated with Herniated Hypertrophic Sublingual Gland

be careful, don’t assume it a real mass
Sialolithiazis
Sialadenosis
Abscess

• Tender mass in febrile patient
• Secondary to sialadenitis or ductal obstruction
• Irregular or regular contour
Chronic recurrent sialadenitis

- Enlarged glands with small amorph 2-10 mm hypoechoic areas
- This pattern is also seen in Sjogren’s syndrome

with permission N. Erdoğan
Salivary gland tumors

- Tumors are mostly hypoechoic
- The commonest site is parotid
- Incidence of malignancy: 5-20% parotid, 50-60% submandibular, 80% sublingual and minor salivary gland
LIPOMA

- Range from hypoechoic to isoechoic to hyperechoic
- See linear internal septation
- Difficult to separate from the adjacent fat
- No Doppler flow
Differentiation of Pleomorphic Adenoma and Warthin tumor

Pleomorphic adenoma

- Well-defined
- Hypoechoic
- Distal enhancement
- Mostly solid
- Solitary
- Lobulated
- Slightly vascular
- Mostly peripheral vasc.

Whartin tumor

- Well-defined
- Hypoechoic
- Distal enhancement
- Presence cystic areas
- Oval
- Common multifocality
- Markedly vascular
- Mostly mixed or central vasc.
Malignant salivary gland tumors

- Irregular-poorly border
- Strong vascularity
- Markedly hypoechoic
- Cystic changes
CE DYNAMIC US

<table>
<thead>
<tr>
<th></th>
<th>Whartin</th>
<th>PA</th>
<th>Malignant</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TP</strong></td>
<td>0.74 ± 0.07</td>
<td>1.46 ± 0.29</td>
<td>1.03 ± 0.08</td>
</tr>
<tr>
<td><strong>MTT</strong></td>
<td>0.62 ± 0.12</td>
<td>1.50 ± 0.31</td>
<td>1.06 ± 0.05</td>
</tr>
</tbody>
</table>

Bozzato A. O Head Neck S. 2007
Knopf et al. EJR 2012
Contrast enhancement features on CT for common parotid tumors

SONOELASTOGRAPHY

- **qualitative analysis**-scoring
  - External-internal compression

- **Quantitative**
  - Share Wave (kPa)
  - Acoustic Radiation Force Impulse Imaging (ARFI) (m/sec)

- **Semi-quantitative**-strain ratio
qualitative analysis

SCORE 1. An almost entirely elastic
SCORE 2. Mostly elastic pattern
SCORE 3. Most of the lesion had no strain
SCORE 4. No strain (An almost entirely blue color)

Table. The distribution of 36 benign and malignant salivary gland masses for each score level

<table>
<thead>
<tr>
<th>Histo diagnosis/location (N)</th>
<th>Score level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Benign/parotid (24), submandibular (4)</td>
<td></td>
</tr>
<tr>
<td>Warthin tumor/parotid (10), submandibular (1)</td>
<td>3</td>
</tr>
<tr>
<td>Pleomorphic adenoma/parotid (10), submandibular (1)</td>
<td>-</td>
</tr>
<tr>
<td>Lymphadenopathy/parotid (3)</td>
<td>2</td>
</tr>
<tr>
<td>Lipoma/submandibular (1)</td>
<td>1</td>
</tr>
<tr>
<td>Abscess/parotid (1), submandibular (1)</td>
<td>-</td>
</tr>
<tr>
<td>Malignant/parotid (6), submandibular (2)</td>
<td></td>
</tr>
<tr>
<td>Adenoid cystic carcinoma/ parotid (1), submandibular (1)</td>
<td>-</td>
</tr>
<tr>
<td>Mucoepidermoid ca/parotid (2)</td>
<td>-</td>
</tr>
<tr>
<td>Adenocarcinoma/parotid (2), submandibular (1)</td>
<td>-</td>
</tr>
<tr>
<td>Lymphoma/parotid (1)</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>n</th>
<th>Elastic modulus (kPa)</th>
<th>median (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Whole_Mean</td>
<td>Whole_SD</td>
</tr>
<tr>
<td>Normal parotid parenchyma</td>
<td>49</td>
<td>10.6 (5.3–22.2)</td>
<td>1.9 (0.7–8.5)</td>
</tr>
<tr>
<td>Normal submandibular parenchyma</td>
<td>11</td>
<td>11.3 (5.6–16.2)</td>
<td>1.4 (0.2–3.9)</td>
</tr>
<tr>
<td>Pooled malignant diagnoses</td>
<td>5</td>
<td>13.5 (9.0–132.0)</td>
<td>4.6 (1.4–52.2)</td>
</tr>
<tr>
<td>Mucoepidermoid Ca (high grade)</td>
<td>2</td>
<td>107.0 (81.9–132.0)</td>
<td>44.2 (36.1–52.2)</td>
</tr>
<tr>
<td>Myoepithelial carcinoma (high grade)</td>
<td>1</td>
<td>9.1</td>
<td>4.2</td>
</tr>
<tr>
<td>Non-Hodgkins lymphoma (B-cell)</td>
<td>1</td>
<td>13.5</td>
<td>1.4</td>
</tr>
<tr>
<td>Nasopharyngeal cancer metastasis</td>
<td>1</td>
<td>8.0</td>
<td>4.6</td>
</tr>
<tr>
<td>Pooled benign diagnoses</td>
<td>55</td>
<td>18.3 (0.0–59.4)</td>
<td>6.0 (1.2–18.9)</td>
</tr>
<tr>
<td>Pleomorphic adenoma</td>
<td>21</td>
<td>22.5 (9.7–59.4)</td>
<td>12.4 (2.9–18.9)</td>
</tr>
<tr>
<td>Warthin’s tumour</td>
<td>18</td>
<td>16.9 (3.8–47.8)</td>
<td>4.8 (1.2–17.4)</td>
</tr>
<tr>
<td>Chronic sclerosing sialadenitis</td>
<td>3</td>
<td>13.7 (10.7–28.3)</td>
<td>5.2 (3.5–6.0)</td>
</tr>
<tr>
<td>Sialocele/cyst</td>
<td>5</td>
<td>11.4 (0.0–18.5)</td>
<td>3.5 (3.4–7.7)</td>
</tr>
<tr>
<td>Reactive node</td>
<td>6</td>
<td>5.8 (13.6–26.9)</td>
<td>6.5</td>
</tr>
<tr>
<td>Lipoma</td>
<td>1</td>
<td>15.9</td>
<td>10.3</td>
</tr>
<tr>
<td>Abscess</td>
<td>1</td>
<td>26.0</td>
<td>6.8</td>
</tr>
</tbody>
</table>

Mean ARFI quantification (m/sec) of the 22 parotid gland tumors

<table>
<thead>
<tr>
<th>Category</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>1.75 ± 0.64</td>
</tr>
<tr>
<td>Pleomorphic adenomas</td>
<td>2.23 ± 0.53</td>
</tr>
<tr>
<td>Malignant tumors</td>
<td>2.58 ± 0.63</td>
</tr>
<tr>
<td>Warthin’s tumors</td>
<td>2.58 ± 0.77</td>
</tr>
<tr>
<td>Other benign tumors</td>
<td>2.64 ± 0.72</td>
</tr>
<tr>
<td>Ductal dilatation</td>
<td>2.89 ± 1.04</td>
</tr>
</tbody>
</table>

Mansour et al. Ultraschall in Med 2012
US-guided biopsy

If the combination of B-mode sonography color Doppler and CEUS and SE are non-specific

US-guided FNAC is effective and safe for diagnosis
FNAC have a similar diagnostic value for determining specific histological types of common parotid masses, when compared with MRI including diffusion-weighted imaging with ADC calculation.

Conclusion

• US is helpful method in differential diagnosis of a wide array of salivary gland lesions
• Use advance imaging if necessary
• SE might partially benefit the improvement of patient management
• When necessary, get tissue diagnosis