Sialolithiasis: Radiological Diagnosis and Treatment

Kiran Kakarala, Harvard Medical School Year III
Gillian Lieberman, MD

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Our Patient: MB

- MB is a 54 year old woman with a history of **Sjögren's syndrome and parotitis** who presented with worsening **facial swelling** over 2 days.

- MB saw her PCP two days prior to admission and was started on Augmentin, but the pain and swelling continued to get worse. **She has had 2-3 episodes of parotitis in the past and has had a sialogram which was negative for obstructing stones.**

- PMH: Sjögren's syndrome, history of parotitis, RTA, nephrolithiasis - left ureteral lithotomy, ADD, frequent dental caries

- Meds on admission: Ibuprofen, **Effexor 75 1.5 bid**, Ritalin 15 tid, Augmentin x 4 days
Patient MB (Cont.)

- Physical Exam: VS: Tm 100.1 BP 110/60 P78 R18 O2Sat 97%
  RA Pain 2-3/10 R face Gen: NAD HEENT: **marked swelling of right face extending from neck to right eye with peri-orbital edema.** Positive tenderness with some erythema extending to left side of chest. PERRLA, EOMI, **positive trismus** Neck: Supple, slight tenderness to palpation of right side of neck
  Rest of exam unremarkable

- Labs: **WBC-20.4** RBC-4.43 HGB-13.6 HCT-39.9 MCV-90
  **NEUTS-69** BANDS-15** R** LYMPHS-10** R** MONOS-6 EOS-0

- CT scan of the head and neck was done in the ED....
The Culprit: A Stone in Stensen’s Duct
Plan

• Before we review the rest of patient MB’s images we need to review:
  • Anatomy of the salivary glands
  • Sialolithiasis: background and epidemiology
  • Pathogenesis of sialolithiasis
  • Differential diagnosis
Anatomy of the Salivary Glands

Parotid glands and Stensen’s ducts:
- The parotid glands are anterior to the external auditory canal, superior to the angle of the mandible, inferior to zygomatic arch.
- Stensen’s duct is 4-7 cm long and drains opposite the upper second molar.

Submandibular glands and Wharton’s ducts:
- The submandibular gland is beneath the mandible and floor of the mouth.
- Wharton’s duct drains the submandibular gland and part of the sublingual gland. It is 5 cm long and 1.5 mm in diameter (larger than Stensen’s). It drains into the floor of the mouth near the frenulum of the tongue.

Sublingual glands:
- Below mucous membranes of the floor of the mouth, drain through Wharton’s duct and directly into floor of mouth.

Cross Sectional Anatomy
Level: C1-C2

Images from: Tufts University School of Medicine Department of Anatomy and Cellular Biology
http://iris3.med.tufts.edu/medgross/headnk07.htm
Sialolithiasis: Background and Epidemiology

• Definition: presence of stones or calculi in the salivary glands or ducts
• 1% incidence at autopsy, but only 27-59/1,000,000 symptomatic cases per year
• 80-92% from submandibular glands, 6-20% from parotid glands, 1-2% from sublingual or minor salivary glands
• More common in men than women, rare in children
• Majority of patients between 30-60 years old
• 75% are single stones, only 3% are bilateral
• Submandibular stones tend to be larger, intraductal. Parotid stones are more often multiple, 50% are within the parotid gland itself

Source: Fazio SB and Deschler DG Salivary gland stones, Up-To-Date 2004
Pathogenesis

• Relative stagnation of saliva that is rich in calcium in a setting of partial obstruction

• Stones are composed largely of calcium phosphate and hydroxyapatite

• Reasons why submandibular gland forms more stones:
  – Wharton’s duct is large and long
  – Salivary flow is slow and against gravity
  – Saliva is more alkaline with high mucin and calcium content

• Dehydration, anti-cholinergic medications (e.g. effexor) and trauma predispose to stones

Source: Fazio SB and Deschler DG Salivary gland stones, Up-To-Date 2004
Differential Diagnosis

- Viral sialadenitis – mumps
- Acute bacterial sialadenitis
- HIV – lymphoepithelial cyst
- Sjögren’s disease
- Sarcoidosis
- Radiation sialadenitis
- Malnutrition – anorexia nervosa, bulimia, beriberi
Differential Diagnosis (cont.)

- Salivary gland tumors
  - 80% are in parotid gland, 80% of parotid gland tumors are benign
  - Benign tumors: Pleomorphic adenoma, Warthin tumor, monomorphic adenoma,
  - Malignant tumors: Various carcinomas, lymphoma (patients with Sjögren’s disease are 44 times more likely to develop lymphoma), metastases
Complications

- **Sialadenitis**
  - Inflammation of the involved gland due to salivary stasis
- **Abscess**
- **Gland atrophy**
  - Decreased salivary flow rates due to atrophy from chronic sialadenitis
- **Recurrence**
  - 18% recurrence after transoral surgical stone removal

(Williams, MF. Sialolithiasis. Otolaryngology Clinics of North America 1999; 32:819)
Patient MB: Imaging
CT neck without contrast

- 3 mm stone in Stensen’s duct
- Massively dilated Stensen’s duct
- Inflamed right parotid gland with surrounding fat stranding
- Ramus of mandible
- Artifact from dental work

Image courtesy of Karen Lee, MD BIDMC
Patient MB: Imaging (cont.)

CT Neck w/ contrast

Enlarged, heterogeneously enhancing right parotid gland consistent with inflammation

Inflamed masseter muscle adjacent to stone in dilated duct

Left parotid gland not well visualized due to dental artifact

Image courtesy of Karen Lee, MD BIDMC
Patient MB: Imaging (cont.)

MRI neck with contrast

- Stone not well visualized

- Stasis of fluid in dilated Stensen’s duct (increased signal)

- Inflamed right parotid gland with surrounding edema

- Normal left parotid gland and Stensen’s duct – well visualized on MR compared to CT (no dental artifact)
Menu of Diagnostic Imaging

- Plain Films
- CT
- MRI
- X-ray Sialography
- MR Sialography
- Ultrasound
Plain Film and CT

- 80-95% of Submandibular calculi are radiopaque; only 60% of parotid calculi are radiopaque
- CT scans are 10 times more sensitive than plain film in detecting stones. CT also detects other pathology such as abscess and tumor
- CT has become the workhorse for imaging sialolithiasis
- Contrast and non-contrast CT scans should be compared to avoid misidentifying contrast filled small vessels seen on end within glands as stones
X-ray Sialography vs. MR Sialography

• X-ray sialography method: the affected duct is cannulated and contrast is injected, plain films are taken, and subtraction images can be made.

• Contraindicated in patients with acute sialadenitis (like patient MB) and patients with contrast allergies.

• MR sialography is non-invasive and does not require ionizing radiation, however the procedure is still being perfected.
X-ray Sialography vs. MR Sialography

64-year-old man with a large sialolith in the main parotid duct.

Ultrasonography

Patient 3: Ultrasound

Advantages: non-invasive, fast, widely available

Disadvantage: results are operator skill dependent

Ultrasound can detect up to 90% of salivary duct stones

Approximately 20-40% sialoliths are not opaque on plain films; sonographically, it is possible to detect the majority of these stones.

Patient 4: Gallium-67 scanning of a 50-year-old woman who had swelling of the left submandibular region.

Cover image from: Annals of Nuclear Medicine February 2002 Vol. 16 No. 1
Plan

• Now that we have reviewed the menu of diagnostic imaging, we can review some cases to see the imaging modalities in action and compare their relative strengths and weaknesses

• We will then conclude by reviewing recent advances in the treatment of sialolithiasis
Patient #5: Stone in Stensen’s duct; now you see it, now you don’t

X-ray Sialogram: The stone is well visualized within the duct (arrow). The dilated intraglandular ducts and the duct distal to the stone are also well visualized.

MR Sialogram: Distal stenosis of Stensen’s duct is seen (large arrow), but the stone is not well visualized. The curved arrow indicates a duct from an accessory parotid gland.

Patient #5 (cont.)

Axial MRI: Stenosis in the right Stensen’s duct is well visualized, but the stone is not clearly seen (large arrow). The normal anatomy on the left side is well visualized (arrowheads).

Transverse Ultrasound: The margins of the stone (arrow) are delineated by the crosshairs. Stensen’s duct (S) is dilated.

Patient #6: 45 year-old woman with recurrent submandibular glandular swelling during mastication

MR sialogram: stone (arrowhead) with dilated intraglandular ducts (arrows)

X-ray sialogram: stone at hilum of gland (arrowhead) with dilated distal Wharton’s duct (arrow)

Patient #7: 64 year-old man with abscess from sialolith

Enhanced CT shows abscess formation around a large sialolith (arrow) in right floor of the mouth, demarcated by a slightly enhanced, broad rim (arrow heads).

T2-weighted MR image shows extension of inflammation in the floor of the mouth, beyond affected gland involving right sublingual gland (arrow).

Treatment of Sialolithiasis

• Conservative Treatment
  – Hydration, moist heat, sialogogues (e.g. lemon drops), d/c anticholinergics, NSAIDs for pain
  – Infection: most commonly staphylococcus species; Antibiotics for 7-10 days
  – Stones less than 2mm in diameter often pass on their own, do not require surgery

• Surgery
  – Transoral approach for stones in distal portion of duct, especially submandibular
  – Parotidectomy – up to 29% risk of facial nerve injury

Source: Fazio SB and Deschler DG Salivary gland stones, Up-To-Date 2004
Treatment (cont.)

- Extracorporeal Shockwave Lithotripsy
  - Best for intraductal stones less than 7 mm in diameter and identifiable by ultrasound

- Sialoendoscopy
  - Laser lithotripsy via endoscope, can reach small stones not accessible by transoral approach

- Interventional Radiology
  - Wire basket extraction under fluoroscopic guidance
  - Best for extraglandular, mobile stones

Source: Fazio SB and Deschler DG Salivary gland stones, Up-To-Date 2004
Shock Wave Lithotripsy


Patient 8 x-ray sialogram, pre therapy: dilated duct with stone (circled)

Patient 8 x-ray sialogram 3 Months post lithotripsy: normal duct
Interventional Radiology

Fig. 1. Subtracted parotid sialogram in the occipito-mental position showing the path of the parotid duct and a stone located within the distal third of the main duct (arrow).

Fig. 2. Sialogram showing three stones trapped within a Dormia basket.

Fig. 3. Surgical release of a stone within a Dormia basket from the submandibular duct orifice by minimal papillotomy incision.

Captura Helical Stone Extractor, Cook Urological, USA

Image from: http://www.cookurological.com/products/pediatric/3_02/3_02_03.html

Image from: Brown JE et al Minimally Invasive Radiologically Guided Intervention for the Treatment of Salivary Calculi CardioVascular and Interventional Radiology Volume 25, Number 5 October 2002 352 - 355
Summary

• Sialolithiasis: presence of stones or calculi in the salivary glands or ducts
• 80-92% from submandibular glands, 6-20% from parotid glands, 1-2% from sublingual or minor salivary glands
• Menu of diagnostic imaging: CT, MRI, Sialogram (X-ray or MR), Ultrasound
• The general strengths and weaknesses of each of these modalities is well illustrated by their application to this disease
• Treatments: conservative, surgery, shock wave lithotripsy, sialoendoscopy, interventional radiology (basket retrieval)
References

5. Fazio SB and Deschler DG Salivary gland stones, UpToDate 2004
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