Challenges of Changing to Ultrasound Versus CT or MRI for Evaluation of Salivary Gland Disorders

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ABSTRACT

Educational Objective: At the conclusion of this presentation, the participants should be able to 1) learn a new paradigm using office based ultrasound for evaluating and managing salivary gland diseases, including sialolithiasis and neoplasms, and its integration with sialoendoscopy; 2) learn how ultrasound for these clinical indications reduces costs, inconvenience, time to diagnosis, exposure to ionizing radiation, intravenous contrast and laboratory tests.

Objectives: Demonstrate the utility of ultrasound in the evaluation and management of salivary gland disorders.

Study Design: Cost effectiveness analysis and decision analysis; diagnostic accuracy; retrospective review from 2000-2012.

Methods: Adults with sialolithiasis and salivary gland neoplasms were evaluated in an university academic or veterans administration hospital with CT, MRI and/or ultrasound. Outcome measurements: type of treatment; resolution of abnormality. Independent variables: age of patient; type of pathology.

Results: CT scan and occasionally multiple CT scans or MRI were the most frequent primary diagnostic study used to confirm, evaluate or follow salivary gland disorders including sialolithiasis and neoplasms. Ultrasound identified and differentiated salivary gland disorders including sialolithiasis, non-neoplastic conditions and benign or malignant neoplasms. Over the last three years, our paradigm has shifted to increased use of ultrasound in lieu of CT or MRI for evaluating salivary gland disease. There are surmountable barriers to the use of ultrasound in the evaluation of salivary gland disease.

Conclusions: Office based ultrasound should be the diagnostic study of choice for evaluation of suspected salivary gland disorders including sialolithiasis and neoplasms. Ultrasound reduces costs, risks, inconvenience to the patient, time to diagnosis, exposure to radiation and improves system efficiency.

BACKGROUND

Imaging of head and neck provides valuable and noninvasive evaluation of patients[1] which is helpful in determining further management. Historically Computed Tomography (CT) has been used to evaluate salivary gland lesions. CT provides important and useful information on anatomy and pathology. Even though biologic effects of ionizing radiation were recognized as early as 1896, 4 months after Roentgen's discovery of x-ray, radiation injuries from diagnostic and therapeutic imaging (as in cardiac catheterization) still occur in the 21st century[2,3]. In 2010 the FDA launched an initiative to reduce unnecessary radiation exposure from medical imaging.[4] A 3 fold increase in the number of CT scans occurred over a 15 year period ending in 2007, resulting in 72 million CT scans in the US alone.[5]

Pearce[6], in particular, noted for children with normal life expectancy, the lifetime excess risk of any incident cancer for a head CT scan (with typical USA dose) is about one cancer per 1000 head CT scans for young children (<5 years) decreasing to about one cancer per 2000 scans for exposure at age 15 years.

Some practitioners may therefore switch to other imaging modalities to reduce these risks. Magnetic resonance (MR) imaging avoids ionizing radiation, but is slow, prone to artifact, expensive, and often requires repeat visits. As MR acquisition time tends to be slower many children require sedation for good quality images.

Ultrasound of the head and neck offers cost effective point-of-care imaging without radiation exposure, intravenous contrast or confined spaces. Although relatively few Otolaryngologists currently use office-based ultrasound in their daily practices, more will do so in the future due to the overwhelming advantages it offers to patients and practices. Otolaryngologists have an unique understanding of the three-dimensional anatomy of the head and neck and therefore, point-of-care ultrasound by an experienced Otolaryngologist can provide patients with timely and thorough assessments of the region.

MATERIALS & METHODS

Following approval by both the Indiana University Human Research Protection Program, and the Department of Veterans Affairs Institutional Review Board, we retrospectively evaluated the records of adults with sialolithiasis and suspected salivary gland lesions. These subjects had been evaluated either in an university academic or Veterans Administration hospital setting. Evaluation started with history and physical exam. At the discretion of the treating physician, some subjects underwent imaging. Modalities included plain film sialogram, computed tomography (CT), magnetic resonance (MR) and/or ultrasound. Statistics were descriptive only.

DATA

We retrospectively evaluated 214 subjects who presented for evaluation of suspected salivary gland abnormalities. Some of these subjects had more than one gland involved. We tallied the data by gland; 222 glands were involved. The encounters occurred during the period 2000 – 2012. (Table 1).

Table 1. Pathology

	N	Sex	Stone	adenitis	duct stenosis	Sialo-cele	Mucous plug	polyp	Sjögren's	benign neoplasm total	Malignant neoplasm	Other
Parotid	130	82M:48F	40	17	13	2	5	1	3	31	16	8
Submandibular	92	51M:41F	69	18	2	0	0	0	0	2	2	1
Total	222	133M:89F	109	35	15	2	5	1	4	33	18	9

3 patients had 2 diagnoses
Benign neoplasms: Warthin, pleomorphic, monomorphic, oncocytoma, basal cell adenoma
Malignant: metastatic papillary thyroid cancer, squamous cell carcinoma, metastatic squamous cell carcinoma, poorly differentiated squamous cell carcinoma, skin squamous cell carcinoma (direct extension), adenoid cystic carcinoma, melanoma, metastatic sebaceous cell carcinoma, lymphoma, mucoepidermoid carcinoma, adenocarcinoma
Other: cysts, lymphadenopathy, diffuse enlargement, benign lymphoepithelial cyst

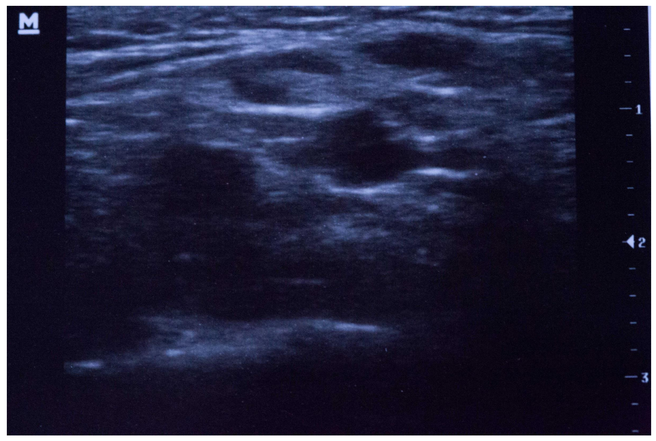
Table 2. Age distribution

Gland	Age (y) (± Standard deviation)
All subjects	52.7 ± 13.6
Parotid	54.8 ± 13.4
Submandibular	49.8 ± 13.5

Table 3. Imaging

	Number	With contrast
Computed Tomography	122	116
Magnetic Resonance	17	17
Plain film sialogram	14	14
Ultrasound	55	0
No imaging	18	0

A number of subjects had more than 1 imaging study.
All of the ultrasounds were performed in since January 2009.



Sjögren's in parotid

Left submandibular stones

DISCUSSION

Early on in our series, CTs were the primary imaging method. This included contrast and non-contrast scans. All MR scans were performed with contrast. Over time, as we have become more comfortable with performing ultrasound examinations in the office, we have used ultrasound more. Additionally, this allowed us to perform fine needle aspirations under ultrasonic guidance at the initial visit when indicated. This approach avoided the time and cost of scheduling a CT or MR and then having the patient return for the imaging evaluation. Ultrasound also avoided the risks associated with intravenous contrast. As a result, this approach reduced the time to diagnosis, so that definitive treatment could be instituted.[7] Notably 18 subjects did not receive imaging, as the diagnosis was made on history and physical exam alone. This reminds us that not all patients require imaging. However, if the diagnosis is not clear, then a reasonable next step is to obtain an image, and if necessary, a tissue diagnosis, such as by fine needle aspiration.

Challenges in moving to ultrasound include training of personnel, availability of equipment, ready accessibility to on-site cytopathology, as well as institutional issues with billing and reimbursement for the imaging. Medical schools are now providing training for medical students to be become proficient in ultrasound examinations.[8] Though expensive, ultrasound machines are less expensive than CT or MR machines, are more mobile, avoid ionizing radiation, and often avoid the need for sedation or general anesthesia.

CONCLUSIONS

Office based ultrasound should be the diagnostic study of choice for evaluation of suspected salivary gland disorders including sialolithiasis and neoplasms. Ultrasound reduces costs, risks, inconvenience to the patient, time to diagnosis, exposure to radiation and improves system efficiency.

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