MRI Directed Interstitial Thermal Ablation of Breast Fibroadenomas

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Introduction:
Fibroadenomas are the most common benign solid breast tumors and are commonly found in women aged 30 to 35. They are composed of mixed glandular and mesenchymal elements and usually grow to a maximal diameter of 2-3 cm. They are rarely malignant. Pain and tenderness is a common presentation, and occasionally an inflammatory response may ensue causing associated axillary lymphadenopathy making it difficult to distinguish clinically from carcinoma.

The majority of fibroadenomas can be accurately diagnosed using a combination of clinical examination, imaging, and needle biopsy. After histologic documentation of a fibroadenoma, conservative therapy without further treatment is routine. Although the safety of conservative management of fibroadenomas has been shown, the degree of patient acceptability of this type of care is variable due to the uncertain natural history of untreated fibroadenomas. Therefore, some patients prefer to have fibroadenomas removed. Only 16-37% of fibroadenomas spontaneously resolve over a period of 1-3 years.

Surgical excision carries the risks of anesthesia, hemorrhage, infection, scarring and particularly disfigurement when dealing with recurrent or multiple fibroadenomas of the breast. Minimally invasive percutaneous procedures offer a simpler, less invasive technique that can safely destroy the tumor and achieve maximal cosmesis with minimal morbidity. Percutaneous techniques also potentially offer greater patient comfort, shorter hospitalization, and cost savings.

Interstitial laser photocoagulation (ILP) is a minimally invasive technique used to ablate tumors within solid organs. It is a percutaneous technique in which the target organ or tumor is slowly heated to temperatures exceeding the threshold for protein denaturation causing cell death. ILP has been used to treat tumors of the liver, brain, pancreas and breast with promising initial results.

Purpose:
The purpose of this study is to investigate the potential role of ILP in the local ablation of breast fibroadenomas and to monitor the response to therapy with magnetic resonance (MR) imaging and serial ultrasonography. Additionally, a patient survey was taken to compare relative preferences of surgery, ILP and conservative therapy from patients who have had more than one treatment experience.

Methods:

Patient population: A total of 24 women between the ages of 18 and 40 years were enrolled in the study after obtaining informed consent. Prior to interstitial laser therapy, needle biopsy and imaging was performed confirming a benign fibroadenoma.

Imaging: Real-time ultrasound images were obtained (Acuson 128, Acuson, Mountain view, CA) using a linear 7 MHz transducer. Ultrasound was the preferred and most common method used for needle placement. All MRI images were obtained on a 1.5 Tesla magnet (General Electric, Milwaukee) using the RODEO (Rotating Delivery of Excitation Off-resonance) pulse sequence. Pre- and post-gadolinium contrast (0.1 mmol/kg, Nycomed, Princeton) high resolution 3D images (256x256x128, 5 min scan time) were generated for lesion characterization.

Laser: Interstitial therapy was performed with a Diomed 25 (Cambridge, UK) continuous wave diode laser operating at 805 nm. Each tumor received 1-4 treatments with the laser at 2 Watts for a duration of 500 seconds per treatment. The laser treatment was interactively controlled by real-time ultrasound or by dynamic RODEO breast MRI. This interactive control allowed adjustments of the laser fiber position during the treatments.

Procedure: Local anesthesia was given at the puncture site and around the tumor with the specific aim of anesthetizing the tissues between the tumor and skin and near the chest wall. One or more 18 gauge MRI compatible needles (EZM), each with an optical fiber, were placed into the tumor using ultrasonography with the aim of completely treating the lesion with overlapping (maximum 18 mm diameter) thermal ablation zones. After deploying the laser fiber tip through the 18-gauge needles, the laser was activated and the ablation process was monitored by either real-time ultrasound or by a dynamic MRI acquisition. A high resolution MR sequence with contrast was performed on all patients post-treatment to better define the degree of ablation. Serial ultrasound examinations were performed at 2 weeks post-treatment and at 1-2 month intervals thereafter. Surgical excision was not performed, therefore there was no post-ablation pathology correlation.

Results: All laser treatments were undertaken using 1-4 fibers. The median size of each tumor prior to treatment by ultrasound was 26 mm (range 14-35 mm). Real-time ultrasound was used to follow the ablation process and subsequent follow up. In all cases, serial examinations by ultrasound demonstrated a significant reduction (mean > 75% reduction in tumor size) in tumor size at 5 months. Post treatment MRI more accurately estimated the degree of ablation as compared to ultrasound (Figure 1), and was able to better estimate residual viable tumor in all cases. The usual sonographic appearance of the fibroadenoma just after treatment was development of ill-defined margins with central areas of increased echogenicity and an overall slight increase in tumor size. The increase in size was minimal and represented surrounding edema.

Conclusion:
Percutaneous interstitial laser photocoagulation has considerable potential as a less invasive technique for localized ablation of fibroadenomas. The procedure is well tolerated by patients and the outcomes are favorable. Adequate guidance and monitoring can probably be achieved with ultrasound, although MR imaging gives a more accurate picture of the extent of laser induced necrosis.

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