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LETTER

High-Intensity Focused Ultrasound Effect in Breast Cancer Nodal Metastasis

Gianluigi Orgera · Giuseppe Curigliano · Miltiadis Krokidis · Guido Bonomo · Lorenzo Monfardini · Paolo Della Vigna · Maria Giulia Zampino · Franco Orsi

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To the Editor,

The aim of this letter is to describe our experience with the treatment of a nonresectable retroperitoneal lymph node with high-intensity focused ultrasound (HIFU).

A 69-year-old woman developed a malignant tumor in the left breast in February 2006 and underwent quadrantectomy and sentinel lymph node excision at our institution. Pathological examination showed invasive mixed ductal and lobular carcinoma, and no invasion was seen in the adjacent blood vessels, lymphatics, or lymph nodes. The patient also has a past positive oncologic history for squamous cell carcinoma of the anal canal, which was treated with radical surgery and radiochemotherapy 2 years earlier, with no evidence of recurrence at the time of the quadrantectomy.

After breast tumor excision, the patient received radiotherapy (21 Gy) and adjuvant hormonal therapy from May 2006 to February 2008. She remained free of disease until March 2008, when in a follow-up ultrasound (US) scan a single 30-mm hypoechoic solid mass was detected close to the hepatic hilum and was considered likely to be a metastatic lymph node. Multidetector computed tomography (MDCT) showed the presence of a large hilar hepatic node with inhomogeneous enhancement after contrast injection. It also excluded any other apparent site of disease. To characterize the finding, percutaneous US-guided core biopsy of the mass was performed using an 18 G needle. Pathology and immunohistochemistry confirmed the presence of metastatic cells from breast cancer.

The surgical team did not consider the patient a suitable candidate for resection due to her history of cardiac failure and existing comorbidities. The lesion was also not considered suitable for percutaneous ablation due to the potential risk of thermal injury of the adjacent structures; therefore, observation of the lesion and continuation of chemotherapy with nonsteroid aromatase inhibitors was decided. Two months later (May 2009), the lesion showed growth of 1 cm on MDCT. The patient was re-evaluated in a multidisciplinary meeting comprising surgeons, oncologists, radiotherapists, and interventional radiologists. A consensus regarding the patient's disease state was reached, thus leading to a new treatment plan. The patient was enrolled in a phase I study for HIFU treatment of solid tumors associated with chemotherapy using aromatase inhibitors.

The patient had a Karnofsky performance scale score of 80%, with no contraindication to general anesthesia. The lesion was visualized before the procedure using US, and no gas interfered in the acoustic pathway. Informed consent was obtained. She was status NPO for 6 h before the procedure. The skin overlying the lesion was carefully shaved to avoid also any possible interference of hair in the acoustic pathway of HIFU, and a urinary catheter was inserted before treatment.

General anesthesia was administered by the anesthetics team to achieve the patient's complete immobilization and to prevent any pain. A purified-water balloon was used to push and compress bowel loops to avoid the presence of air

G. Orgera (✉) · G. Bonomo · L. Monfardini · P. Della Vigna · F. Orsi
Unit of Interventional Radiology, European Institute of Oncology, Via Ripamonti 435, 20141 Milan, Italy
e-mail: gianluigi.orgera@ieo.it

G. Curigliano · M. G. Zampino
Division of Medical Oncology, European Institute of Oncology, Via Ripamonti 435, 20141 Milan, Italy

M. Krokidis
Department of Radiology, St. Thomas Hospital, London SE1 7EH, UK

in the pathway beam. For this reason there was no necessity for bowel-movement control. After being anesthetized, the patient was carefully positioned prone on the prototype HIFU table, making sure that the skin overlying the target lesion was in contact with the degassed water. A vertical scanning mode was chosen with a 5-mm distance between each slice. HIFU ablation was performed using the JC HIFU system (HIFU Tech, Chongqing, China). The therapeutic procedure was guided by real-time US. Therapeutic US energy was produced by a transducer, with a diameter of 20 cm and a focal length of 15 cm, that operates at a frequency of 0.8 MHz. A MyLab70 US imaging device (Esaote, Genova, Italy) was used as this system's real-time imaging unit. The 1.0–8.0-MHz imaging probe is situated in the center of the HIFU transducer.

By scanning with the HIFU beam, the targeted region in each section was also ablated. This process was repeated on a section-by-section basis to achieve complete ablation of the lesion. During HIFU ablation, the real-time US scans obtained immediately before and after individual energy exposures were compared to determine the change in the ecogenicity of the treated region, which is indicative of the extent of coagulation necrosis. After several sonications, consistent ecogenicity change was observed in the lesion, and this was interpreted as satisfactory tissue ablation, indicating the end of the procedure (Fig. 1).

Total procedure time, including preparation and treatment, was 4 h. Procedure time, defined as the time from the lesion localization to the last sonication, was 2 h and 30 min. We also calculated the total sonication time, defined as the exposure time, which is related to the lesion size and the blood supply, and it was 1400 s. Treatment power used was 350 W.

Computed tomography 24 h after treatment showed lack of enhancement in approximately 90% of the lesion's volume, with the presence of only a thin rim of enhancement, and the result was considered as satisfactory, assuming the formation of necrotic tissue. The patient was discharged the day after the procedure without any symptoms. Follow-up MDCT performed at 5 and at 8 months later showed decreased size of the mass with persistant lack of enhancement, suggesting successful lesion ablation (Fig. 2).

We described treatment, using HIFU, of an isolated lymph node metastasis close to the hepatic hilum in a patient previously affected by mixed ductal and lobular breast carcinoma. The mass grew quickly in a short period time. Surgery was not an option because it would have

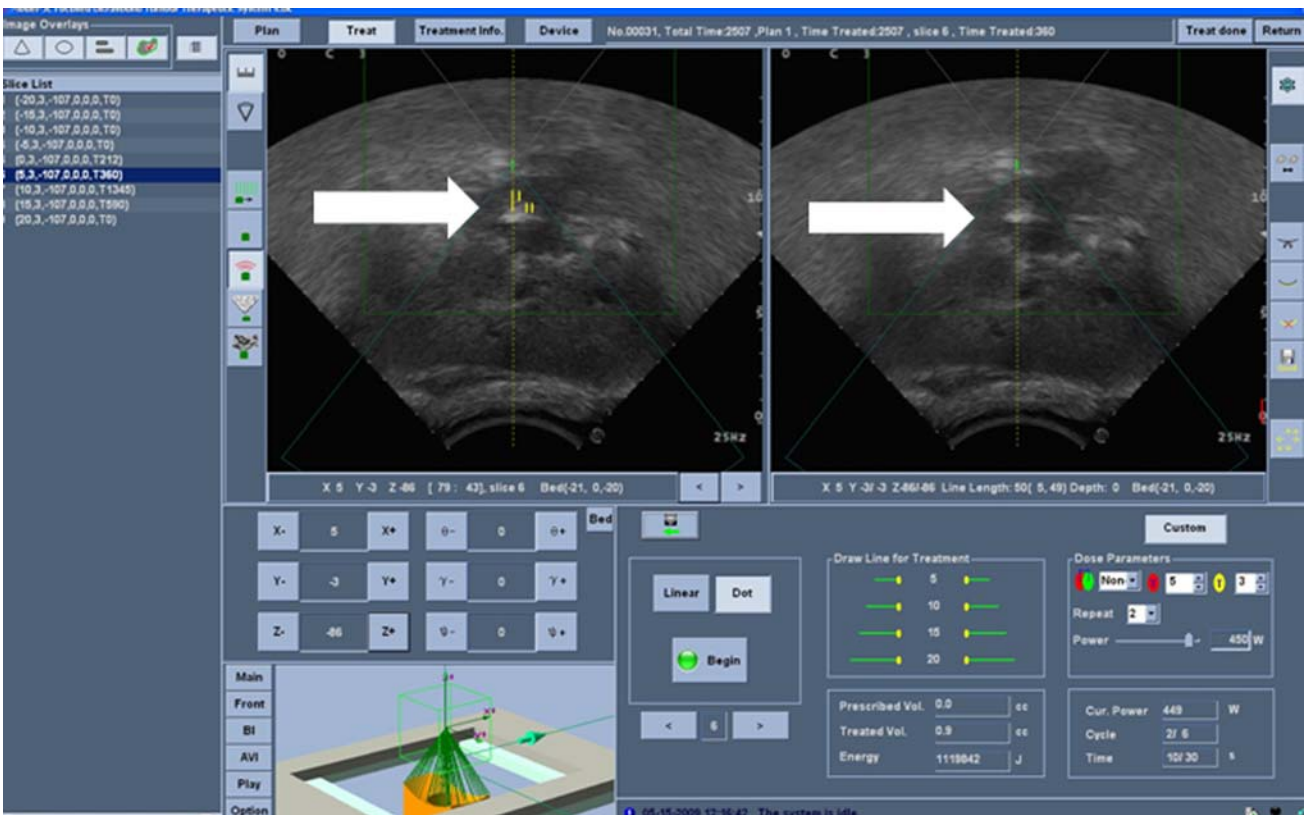

Fig. 1 US during HIFU procedure shows change in echogenicity of the initially hypoechoic mass at the level of the hepatic hilum (*arrow*)

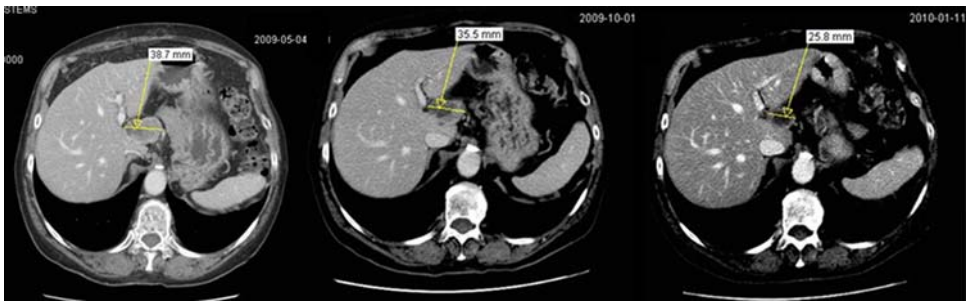

Fig. 2 Follow-up MDCT performed 5 (*middle panel*) and 8 (*right panel*) months after procedure showed hypodence central necrotic area in the middle portion of the lesion with decreased size and enhancement pattern. No sign of compression of adjacent organs is noted. (*Left panel*) Image of the lesion before HIFU treatment

been too invasive considering that we had to deal with metastatic disease several patient comorbidities. Radiofrequency thermal ablation (RFA) would have been another option. Nevertheless, in our case, the location of the lesion would have made the intervention rather challenging due to needle insertion, and there was a possibility of risk of thermal injury to the anatomic structures adjacent to the lesion.

After a multidisciplinary meeting, treatment with HIFU was decided. HIFU is a minimally invasive method of ablation therapy that uses focused US energy from an external source, which is targeted within the body, resulting in thermally induced necrosis [1]. It does not require insertion of a needle into the target area, and damage of the tissue is obtained by the thermal effect and cavitation, which is caused by US energy. Acoustic energy is absorbed, and heat is generated by delivering high-acoustic intensity to the tissue. Because it is highly focused, acoustic intensity is high only within the focal region; however, outside the focal region the intensity is substantially lower, thus minimizing the risk of unintended injury to the surrounding structures. Unlike RFA, HIFU is completely noninvasive and can be used to reach tumors deep within the body, as in this case, provided there is an acoustic window to allow the transmission of US energy.

The limitations of this method are the fact that in most cases general anesthesia is required, that the ablation may not be radical, and that we still do not know the long-term results of this procedure.

We believe that HIFU may offer another chance for those patients with abdominal lymph nodal metastases and no indication for any other minimally invasive approach. HIFU appears to be a valid alternative therapeutic strategy that may easily be repeated, thus providing good local tumor control.

Reference

1. Dubinsky TJ, Cuevas C, Dighe MK et al (2008) High-intensity focused ultrasound: current potential and oncologic applications. AJR Am J Roentgenol 190:191–199