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LETTER TO THE EDITOR

Re: de Assis et al. "Effects of Prostatic Artery Embolization on the Dynamic Component of Benign Prostate Hyperplasia as Assessed by Ultrasound Elastography: A Pilot Series"

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To the Editor,

We read with interest the article of de Assis et al. regarding the effects of Prostatic Artery Embolization (PAE) on the elasticity of hyperplastic prostatic tissue [1]. The authors utilized a dedicated sono-elastographic technique (shear wave elastography—SWE) to quantitatively evaluate the elasticity of the prostate before and after PAE for the treatment of benign prostatic hyperplasia (BPH). They demonstrated a significant post-therapeutic reduction in prostatic stiffness, thus providing a new insight into the mechanisms of improvement in the dynamic component of BPH by PAE.

Taking advantage of this letter, we would like to briefly describe our initial experience in the same field and to compare our results with those of the original works of de Assis et al. We utilized strain elastography (SE), which is a less sophisticated but more widely available sono-elastographic technique, compared to SWE. SE is based on the analysis of tissue deformation caused by a mechanical stimulus. The latter, in the case of the prostate, is induced by slight compression and decompression of the prostate with minimal forward and backward movements of the transrectal probe [2]. By comparing the tissue before and after compression, the degree of local tissue deformation (strain) is estimated in real time and projected on a color map (elastogram). Stiff tissues exhibit a reduced strain, while soft tissues have an increased strain. The most appropriate SE elastograms are those acquired *during* the time of forward and backward movements of the probe and not when compression is fully relieved. A quality index, displayed on the screen next to the elastogram, assists the operator to adjust the optimal strength and frequency of the probe movements [2]. In contrast to SWE, SE does not provide absolute values of tissue stiffness in kPa or m/sec. Instead, a ratio is calculated, by comparing the stiffness of the target area with a reference area of the image. In our work, we utilized the elasticity (E) index, which is defined as the average strain in the target area divided by the average strain in the entire elastogram [3]. An arbitrary scale (0-softest, to 6-hardest) is used for the E-index; values 0–1 indicate a softer target (with higher than the average strain) and values > 1 indicate a harder target (with lower than average strain).

We studied 11 patients with symptomatic BPH, before and approximately 1 month post-technically successful bilateral PAE. Transrectal SE was performed as per WFUMB guidelines [4]. We utilized a Logiq E9 XD clear ultrasound unit (General Electric, GE Healthcare, Milwaukee, WI, USA) with SE capability and with a 4–9 MHz, wideband, endocavity microconvex probe. According to our standard imaging protocol [5], the patients had also been studied with contrast-enhanced ultrasonography (CEUS), and extensive, bilateral, PAE-induced prostatic infarctions were demonstrated in all of them. We eventually managed to produce technically adequate elastograms at comparable sections of the prostate before and after PAE in only five of these patients. For

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Table 1 Values of the E-index (mean ± standard deviation) before and after PAE and significance of their changes

	Baseline	1 month post-PAE	Change (%)	p*
Ep[a]	2.51 ±/0.34	2.10 ±/0.23	15.9 ±/5.2	< 0.05
Et[b]	3.04 ±/1.51	1.92 ±/1.53	32.6 ±/28.5	< 0.05

*Statistical significance was calculated with the Wilcoxon signed-rank test

[a]Ep: E-index calculated for the entire prostate at the selected sections (2 sections–2 measurements per patient, total of 10 measurements)

[b]Et: E-index calculated at the center of the transitional zone of each lobe at the selected sections (2 sections–4 measurements per patient, total of 20 measurements)

each of them, we selected two representative axial sections at the middle third of the prostate. A ROI encompassing the entire prostate was defined at each section, and the E-index (Ep) was calculated. To specifically examine the changes of the transitional zone, we placed a circular 10 mm ROI at the center of the transitional zone at each prostatic lobe at the aforementioned representative axial sections. The E-index for the transitional zone (Et) was subsequently calculated. Comparison of the E-index values before and 1 month post-PAE revealed a moderate but statistically significant reduction in both Ep and Et (Table 1). These results are in line with those of de Assis et al. and indicate a post-PAE reduction in the stiffness of the prostate, more prominent in the transitional zone. Of note, PAE resulted in clinical success in all five patients at 1- , 3- and 6-month follow-up.

We also evaluated visually the elastograms and the corresponding CEUS images and compared the extent and location of the prostatic infarcts (shown by CEUS) with the color changes on the elastograms post-PAE; the infarcts were constantly far more extensive and easily detectable than the elastographic color changes, and correlation between CEUS and SE images was overall poor (Fig. 1). It is probable that softening of the ischemic tissue is not homogeneous, or longer time may be required until more striking elastographic changes can be detected.

Both sono-elastographic techniques appear to have several limitations (probably more serious for SE); however, the initial results of both techniques are remarkable and may facilitate the understanding of the modes of action of PAE. Sono-elastography, along with CEUS, could enhance the role of ultrasound as a tool for integrated imaging evaluation post-PAE.

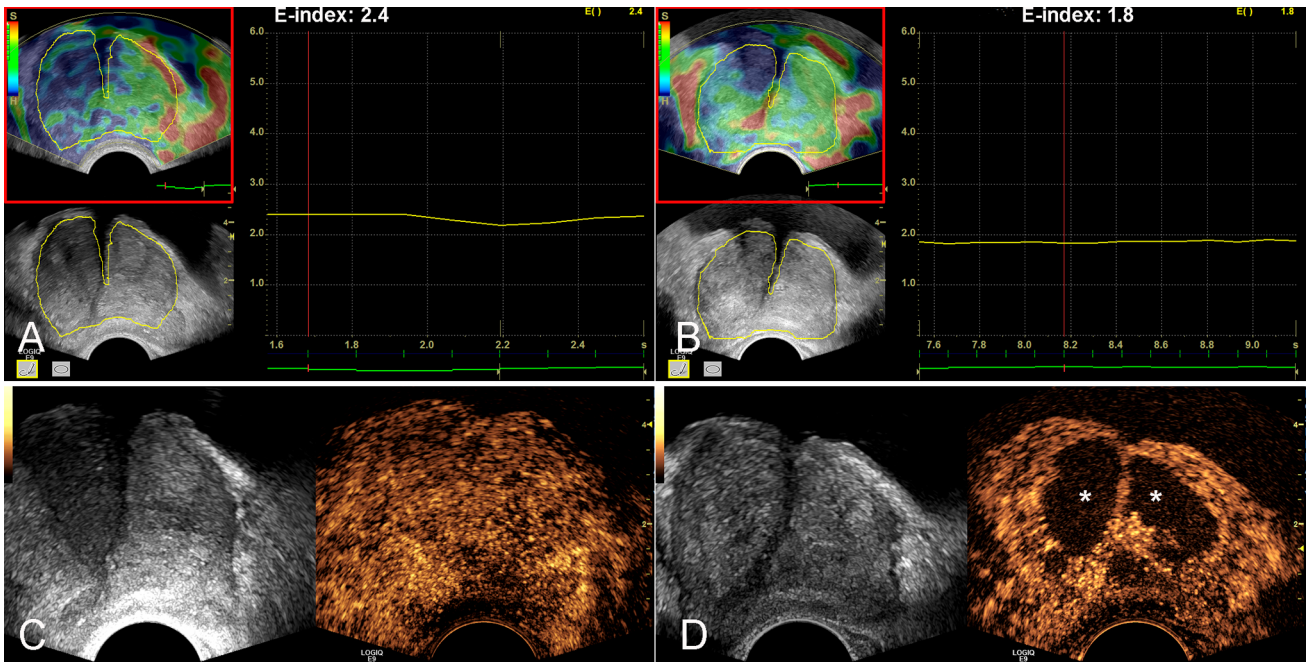

Fig. 1 Study of the prostate with transrectal SE before and 1 month post-PAE and correlation with CEUS. Comparison of the elastograms (in red frames) before (**A**) and after PAE (**B**) shows increased elasticity post-PAE, indicated by newly appearing (or increasing) red, yellow and green ("soft") areas and by relative shrinkage of the blue/light blue ("hard") areas within the prostate. Calculation of the E-index with a ROI encompassing the entire prostate at the selected sections showed a decrease post-PAE, from 2.4 to 1.8. Corresponding sonographic images from the same case before (**C**) and after PAE (**D**), on "split screen" mode (unenhanced, reference B-mode capture on the left side, CEUS capture on the right side of each image). Non-enhancing ovoid infarcts (asterisks) are clearly evident on the CEUS post-PAE; however, their distribution does not correlate closely with the newly appearing "soft" areas of post-PAE elastogram. This patient, with recurrent symptomatic BPH several years after transurethral resection, experienced significant clinical improvement post-PAE

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval The patients and methodology of this work were included in a larger, ongoing study, regarding the sonographic evaluation of PAE with several techniques. Institutional Review Board (IRB) approval had been obtained for this study. All procedures were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Consent for Publication Consent for publication was obtained for every individual person's data included in the study.

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