



# A structured framework for optimizing high-intensity focused ultrasound ablative treatment in localized prostate cancer

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High-intensity focused ultrasound (HIFU) treatment has recently been pursued to reduce radical treatment-related morbidity in low-to-intermediate-risk localized prostate cancer (PCa), especially in older men. The aim of this study was to develop a dedicated framework for HIFU therapy. All clinical data, such as risk categories, magnetic resonance with functional parametric imaging, and histopathology, are essential for driving proper HIFU treatment. All needed data can be added to the framework to localize areas that need to be treated. Once PCa areas have been featured, quantified, and located, planning can be adapted to drive accurate HIFU treatment. Our planning framework may be useful for all ablative therapies in order to standardize treatment for both clinical and scientific purposes.

**Keywords:** Ablation techniques; High-intensity focused ultrasound ablation; Planning techniques; Prostatic neoplasms

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## INTRODUCTION

Prostate cancer (PCa) is the second most common tumor after cutaneous malignancy in men, with an estimated 161,360 new cases in 2017, and is the third leading cause of cancer death in the United States [1]. The recent ProtecT trial showed that PCa-specific mortality was low at a median of 10 years irrespective of the treatment assigned (monitoring, surgery, or radiotherapy) in men with localized disease [2], but that treated men reported worse urinary, bowel, and sexual functions and significant effects on quality of life [3]. Therefore, it is clear that radical treatment of localized PCa in most men, particularly the

elderly, may be an overtreatment with severe adverse events, because the survival benefit conferred by radical therapy is seen over 10 to 15 years compared with active monitoring [2]. Several forms of ablative therapy, mainly high-intensity focused ultrasound (HIFU), laser ablation, and brachytherapy, have been pursued to reduce treatment-related morbidity in patients with low-to-intermediate-risk PCa [4]. The medium-term efficacy of HIFU in men with localized intermediate-risk and high-risk PCa was recently demonstrated by Guillaumier et al. [5], who published a large, multicenter study of 5-year outcomes. They reported a failure-free survival rate of 88%, metastasis-free survival rate of 98%, and cancer-

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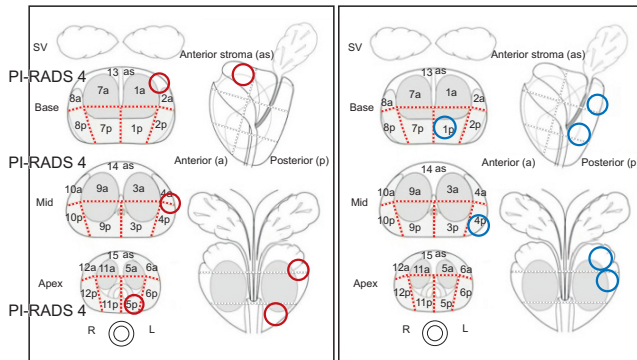
Date \_\_\_\_\_ Prostate cancer localization

First name \_\_\_\_ Last name \_\_\_\_ Date of birth 73 year-old  
Digital rectal examination: negative Total PSA: 6 ng/mL %free: 15 TRUS volume: 27 mL  
Standard biopsy: 12 cores (6 right; 6 left)  
Fusion biopsy: \_\_\_\_\_

Core with cancer	Topographic localization	Cm Core/mm tumor	Gleason
Left lobe: base, median	1p	1,2/1,1	3+3
Left lobe: middle, paramedian	4p	1,4/2,3	4+3

mpMR

BIOPSY



B

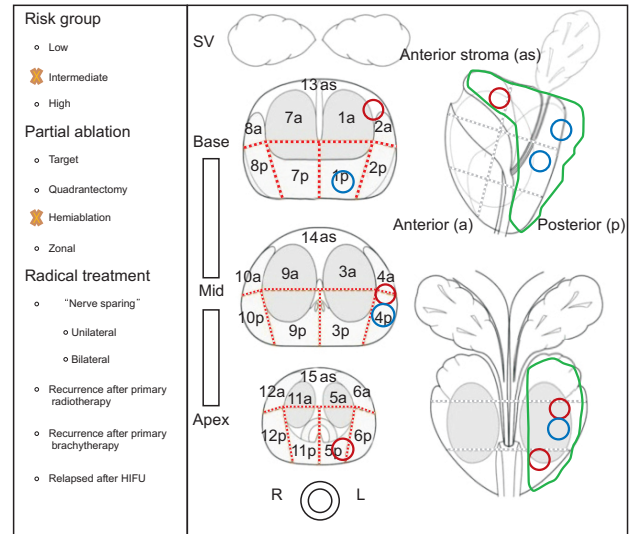
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Date \_\_\_\_\_ HIFU preplanning

First name \_\_\_\_ Last name \_\_\_\_ Date of birth 73 year-old  
Digital rectal examination: negative Total PSA: 6 ng/mL %free: 15 TRUS volume: 27 mL  
Treatment: left hemiablation



**Fig. 4.** Left hemiablation. (A) Red circles: localization of three PI-RADS v2 score 4 lesions found at multiparametric magnetic resonance (mpMR). Blue circles: cancer core localization. (B) Green area encloses ablation target. PI-RADS, Prostate Imaging–Reporting and Data System; PSA, prostate-specific antigen; TRUS, transrectal ultrasound; HIFU, high-intensity focused ultrasound; SV, seminal vesicles.

scale image. Those margins are considered during real-time treatment. To the best of our knowledge, this is the first HIFU dedicated framework. However, this framework may be useful for all available ablative therapies, regardless of the energy used (eg, HIFU, brachytherapy, cryotherapy). In fact, it may be the right way to choose the correct source of energy according to the proposed à la carte model reported by Sivaraman and Barret [10]. Indeed, they proposed to improve outcomes by using different sources of energy, according to cancer location: brachytherapy for apical, cryotherapy for anterior, and HIFU for posterior tumors [10]. Several conceptual frameworks similar to ours are available, most of which have been developed in medical oncology [11–15]. For example, one of the most important was developed in 2013 by the American Society of Clinical Oncology, with the aim of assisting medical oncologists in comparing the clinical benefit, toxicity, and cost of medical treatments [11]. Moreover, Slomiany et al. [16] and Chandra et al. [17] reported the importance and utility of those oncological

frameworks not only in clinical trials but also in clinical practice.

## CONCLUSIONS

In conclusion, we believe that our framework may be a powerful and useful tool to be adopted for providing a standardized approach to assist urologists in ablative treatment planning, considering that focal therapy for PCa is gaining popularity worldwide.

## CONFLICTS OF INTEREST

The authors have nothing to disclose.

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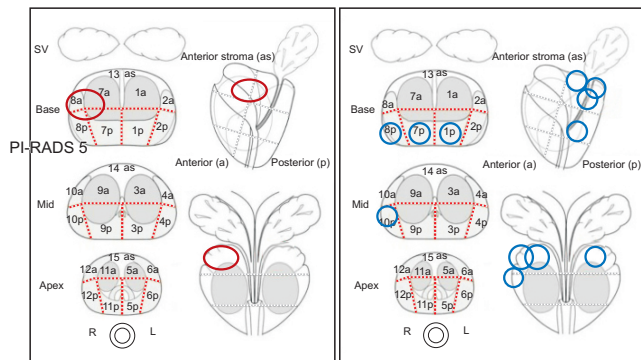
Date \_\_\_\_\_ Prostate cancer localization

First name \_\_\_\_ Last name \_\_\_\_ Date of birth 66 year-old  
Digital rectal examination: positive right to be base Total PSA: 9.6 ng/mL %free: 12  
TRUS volume: 47 mL  
Standard biopsy: 14 cores (7 right; 7 left)  
Fusion biopsy: \_\_\_\_\_

Core with cancer	Topographic localization	Cm Core/mm tumor	Gleason
Left lobe: base, median	1p	1,1/2,1	3+3
Right lobe: middle, paramedian	10p	1,3/3,3	4+3
Right lobe: base, median	7p	0,9/3,2	3+4
Right lobe: base, paramedian	8p	1,2/2,6	3+4

mpMR

BIOPSY



B

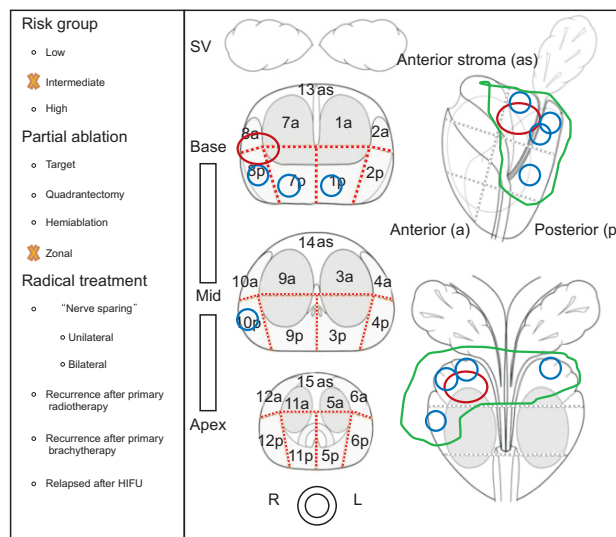
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Date \_\_\_\_\_ HIFU preplanning

First name \_\_\_\_ Last name \_\_\_\_ Date of birth 66 year-old  
Digital rectal examination: positive right to be base Total PSA: 9.6 ng/mL %free: 12  
TRUS volume: 47 mL  
Treatment: Zonal, "hockey stick"



**Fig. 5.** Zonal ablation. (A) Red circles: localization of one PI-RADS v2 score 5 lesion found at multiparametric magnetic resonance (mpMR). Blue circles: cancer core localization. (B) Green area encloses ablation target (hockey stick). PI-RADS, Prostate Imaging–Reporting and Data System; PSA, prostate-specific antigen; TRUS, transrectal ultrasound; HIFU, high-intensity focused ultrasound; SV, seminal vesicles.

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