Neurosurgical Forum LETTERS TO THE EDITOR

Intraoperative ultrasound elastography applied in meningioma surgery

TO THE EDITOR: We read with great interest the article by Della Pepa et al.¹ (Della Pepa GM, Menna G, Stifano V, et al. Predicting meningioma consistency and brain-meningioma interface with intraoperative strain ultrasound elastography: a novel application to guide surgical strategy. *Neurosurg Focus*. 2021;50[1]:E15).

Undoubtedly, the authors did an outstanding job in the application of intraoperative ultrasound (ioUS) elastography in meningioma surgery. Their conclusions support the use of this intraoperative imaging technique in other neurosurgical departments.

That said, we would like to make some additional comments about the article. First, we must mention that it was not Uff et al.² who initially described intraoperative elastography, but Chakraborty et al.³ in 2006. Chakraborty also presented a detailed study of this technique's applicability and described the slip interface in extraaxial tumors in his doctoral thesis, published in 2007.⁴

Second, although Della Pepa et al.¹ mention the use of ioUS elastography to assess the consistency of meningiomas, their article is not the first to report the application of this method. Our group has previously described elasticity patterns through a semi-quantitative analysis of the elastograms in glioma and meningioma surgery.⁵ More recently, we demonstrated an improvement in diagnostic performance by combining elastograms with artificial intelligence.⁶ We also published a study focused exclusively on meningioma surgery, with a similar objective,⁷ in which we added an analysis of the radiomic features of preoperative MRI.

Third, in the report by Della Pepa et al.,¹ the significant discrepancy between the assessment of T2-weighted images and the intraoperative perception of consistency is striking and may have been influenced by the subjective scale established by the authors.

Fourth, the term "predicting" in the title of Della Pepa et al.'s study¹ must be interpreted with caution. Because no model is elaborated in the study, there is no cohort in which any prediction can be validated.

Finally, beyond the observations mentioned above, we congratulate the authors for their work. We hope that multiinstitutional studies will be carried out in the future

to maximize the benefits of this intraoperative imaging modality, which offers an inexpensive alternative to real-time imaging during surgery while still providing a huge amount of information regarding the surgical plan. We believe that ioUS elastography should be considered an essential part of the neurosurgical armamentarium.

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Disclosures

The authors report no conflict of interest.

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Response

We are very grateful to Dr. Cepeda and Dr. Sarabia for their interest in our study and for giving us the opportunity to respond to their comments.

First of all, we thank our colleagues for allowing us to acknowledge the pioneering study by Chakraborty et al.,¹ in which they described the first intraoperative application of an intraoperative ultrasound (ioUS)–based technique to determine focal brain alterations with shear wave elastography.

We would like to commend our colleagues for their excellent research activity about the uses of ioUS elastography in neurosurgery.² Their studies have highlighted the possible advantages of such a technique and have been certainly *an inspiration* for us. Moreover, we read with great interest their recent work, in which they describe how the combination of radiomics, ioUS elastography, and machine learning models can help in defining meningioma consistency.³ This recent work by Dr. Cepeda and colleagues further corroborates the findings of our study and broadens the possible applications of this tool. Indeed, ioUS has recently been undergoing a “rediscovery,” as demonstrated by several publications in this field.^{4–7}

In our study, qualitative ioUS information provided by strain ultrasound elastography (SUE) helped us in different ways. For example, the surgeon was able to get a rough idea of the consistency of the tumor and was also guided to first address the region of the tumor with the lower consistency. Furthermore, the assessment of the brain-tumor interface guided the surgeon during the dissection of the tumor from the surrounding structures. Thus far, such information has been qualitative only and should be regarded as supplementary data for the surgeon. In this regard, we believe that the quantitative data found in the papers by Dr. Cepeda’s group help to increase the utility and reliability of ioUS elastography.³

As a fast, real-time, and low-cost resource, ioUS elastography can be part of a multimodal integration of different technologies for the assessment and treatment of meningiomas. The information provided by this multimodal integration could be widely beneficial to neurosurgeons in their efforts to optimize both preoperative planning and intraoperative strategy, with the final goal to make the surgery safer and more effective.

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