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Radiomic analysis of endometriomas: predicting volumetric and symptomatic response to hormonal therapy

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Objectives: The aim of this research was to evaluate the ability of radiomic analysis, applied to ultrasound images of endometriomas, to predict the volumetric response of these lesions to hormonal therapy. Furthermore, the study investigated the correlation between radiomic features and variations in symptomatology following treatment.

Methods: This retrospective study included premenopausal women attending the Endometriosis outpatient clinic at San Martino University Hospital, Genoa (2022-2025). Clinical and ultrasonographic data were collected to assess monthly variations in lesion volume and VAS pain scores. Gray-scale transvaginal ultrasound images were manually segmented and analyzed via PyRadiomics. Feature selection was performed using Random Forest algorithms, with selected variables incorporated into linear regression models.

Results: A total of 85 women were recruited, 33 of whom underwent serial follow-up evaluations during hormonal therapy. The mean monthly change in endometrioma volume was -0.97 cm^3 , accompanied by a decrease in symptoms (VAS Z-score variation: -0.04). Radiomic analysis revealed that the “*small area emphasis*” feature was a significant predictor of volume reduction in response to therapy (effect = -4.382 ; 95% CI: -7.610 to -1.155 ; $p < 0.05$), while a capsular thickness $> 2 \text{ mm}$ was associated with a volume increase (effect = 3.203 ; 95% CI: 0.938 to 5.467 ; $p < 0.05$). Finally, the “*large area high gray level emphasis*” feature of the entire lesion independently predicted monthly variations in VAS scores (effect = 0.190 ; 95% CI: 0.004 to 0.375 ; $p < 0.05$).

Conclusions: Radiomic analysis of ultrasound images enables the prediction of both the volumetric evolution of endometriomas and the symptomatic response to treatment: capsular radiomic features reflect volumetric changes, whereas features related to lesion content correlate with symptomatic variations. These findings underscore the clinical utility of radiomic signatures in patient stratification, allowing the implementation of tailored therapeutic protocols for ovarian endometriosis.