

Artificial Intelligence For TVS-based Detection Of Deep Endometriosis

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Introduction

Endometriosis affects about 10% of women. The diagnostic delay remains substantial. Reliable transvaginal ultrasound (TVS)-based deep endometriosis (DE) detection typically requires expert operators. This study evaluates whether an artificial intelligence (AI) model trained on expert-annotated TVS images can detect and segment DE lesions on TVS cine clips, as a step toward computer-aided interpretation and future real-time assistance.

Methods

A U-Net-based model was trained on a multicenter TVS cine-clip dataset, comprising healthy cases and pathological cases with diverse endometriosis phenotypes at various locations, excluding superficial endometriosis. The AI model outputs semantic segmentation of anatomical structure and DE lesions (Figure 1). To evaluate the performance of the AI, TVS cine clips of patients suffering from DE were prospectively collected. The ground truth was defined by expert gynecologists in a two-step review workflow; per cine, 2–4 frames were checked for DE and annotated. Performance was quantified using the Dice similarity coefficient on frames with lesions present. For patient-level sensitivity, a case was considered detected (positive) if the model achieved any spatial overlap on at least one lesion-annotated frame for that patient.

Results

The test set included 54 videos from 51 patients with 188 labeled frames. Of these, 171 frames contained an annotated DE lesion, and 17/188 were without lesion. On lesion-present frames, Dice was 0.45 ± 0.28 (mean $\pm$ SD) with a median of 0.53 (IQR 0.23–0.68; max 0.92). Frame-level overlap was observed in 82% (140/171) of lesion-present frames. Patient-level sensitivity was 90% with 46 out of 51 detected DE. 5/51 patients had no overlap on any annotated lesion frame.

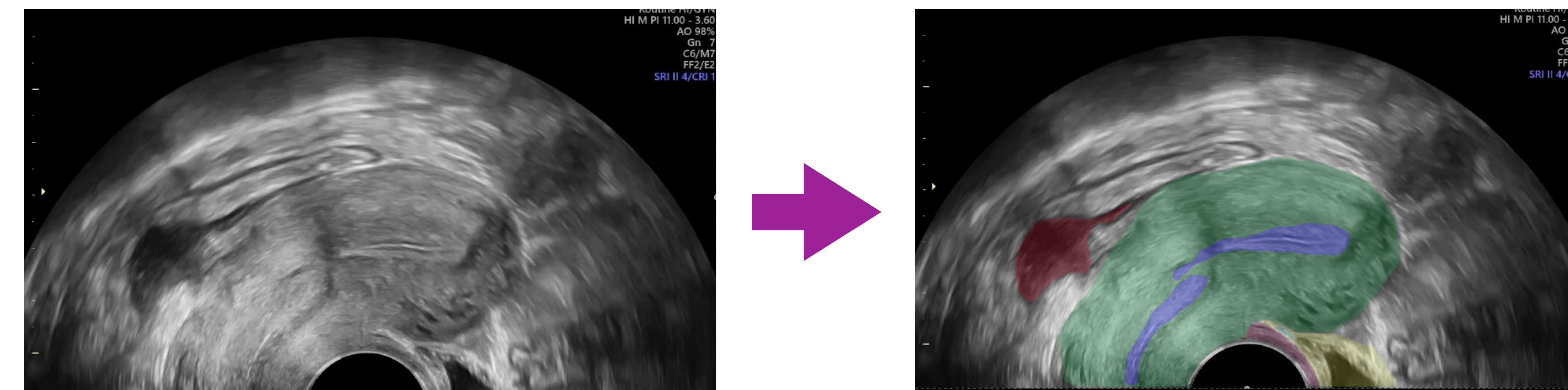


Figure 1. Left: raw TVS-frame; Right: semantic segmentation of organs and DE lesion at the torus uterinus.

Conclusion

An AI model trained from expert annotations in offline TVS cine clips demonstrated encouraging patient-level sensitivity and adequate segmentation agreement for DE. Failure cases appeared consistent with challenging image conditions (e.g., limited exposure, artifacts). We believe that the technology has the potential to serve as a real time-time alerting and decision support tool (Figure 2).



Figure 2. Example of a potential real-time alerting tool used during a TVS examination. The live ultrasound stream is continuously analyzed by the AI model, which provides visual overlays indicating anatomical structures and the potential presence of endometriosis lesions. The AI-generated visualizations are displayed on a separate screen alongside the ultrasound examination.

