Deep Learning-assisted Endoscopic Diagnosis of Laryngopharyngeal Reflux by Recognizing Signs of Chronic Inflammation

ONE-PAGE E-POSTER

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TAKE-HOME MESSAGE

Balanced segmentation + region self-attention enabled rapid LPR-CI diagnosis with 91.4% external accuracy and AUC 0.88.

The manuscript reports performance comparable to senior otolaryngologists, with pathological CD3 evidence supporting the inflammatory phenotype.

Clinical Need & Objective

8-20%	Nonspecific	Experience
reported LPR prevalence	endoscopic signs	drives variability

Objective: Develop an automated, endoscopy-based computer-aided diagnosis approach for accurate identification of LPR-associated chronic inflammation (LPR-CI).

- Manual laryngoscopy can miss subtle edema, erythema, mucus, granuloma and related changes.
- High-confidence alternatives can be invasive, painful, costly or slow (24-hour monitoring or 4-8 week therapeutic trials).

Study Design & Validation

INTERNAL DATASET

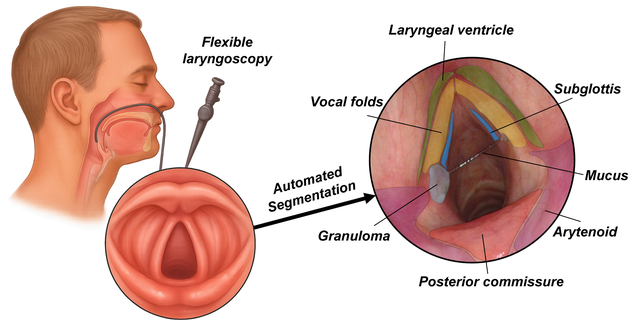
1,061 participants
2,180 laryngoscopy samples
1,593 suspected LPR-CI images (996 positive; 627 negative)
587 non-LPR-CI cases

EXTERNAL VALIDATION

93 participants
6 otolaryngologists (intern, attending, chief)
Reference: 24h-MII-pH; dual validation with PPI/P-CAB in **88** high-confidence cases

Ethics approvals: K2019-03-071 and K2021-04-031. Informed consent obtained.

What the Model Sees



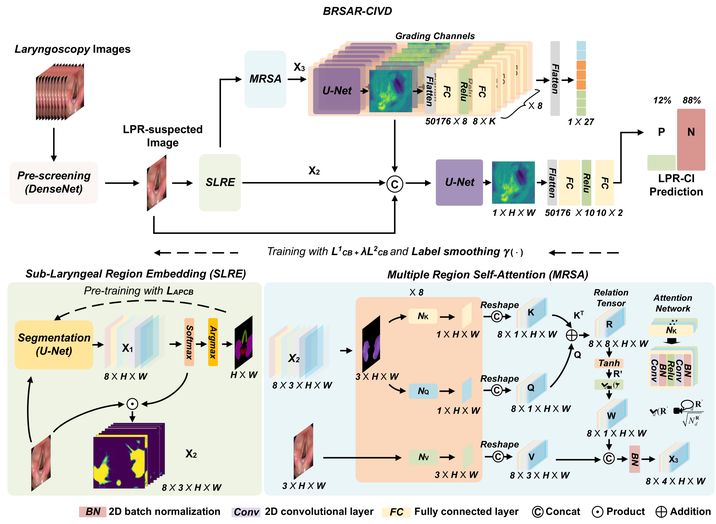
Annotated laryngeal regions and inflammatory signs (manuscript Fig. 3a)

Pre-screen › SLRE + APCB › MRSA attention › LPR-CI output

- APCB loss dynamically balances pixel classes to improve learning from small and imbalanced regions.
- Region embeddings are reconstructed with multi-region self-attention before final LPR-CI prediction.

BRSAR-CIVD Architecture

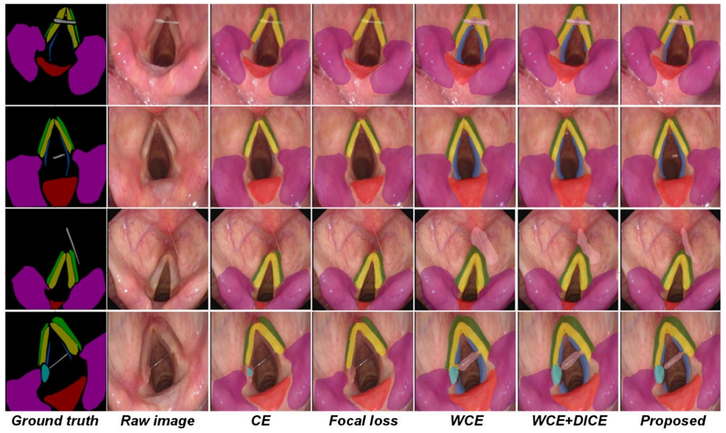
DenseNet pre-screening → SLRE/U-Net semantic embedding → MRSA ROI reconstruction/attention → binary diagnosis



Model architecture and attention modules (manuscript Fig. 6)

Segmentation: Small-Region Performance

APCB U-Net mIoU = 0.696

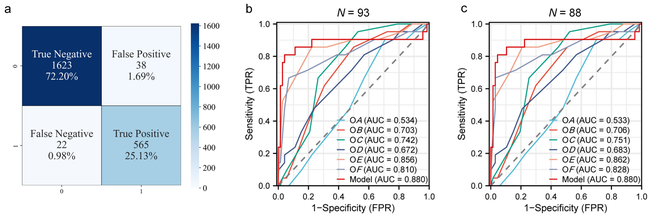


Representative comparisons: CE, focal, WCE, WCE+Dice, and proposed APCB-based approach (Fig. 3)

External Diagnostic Performance

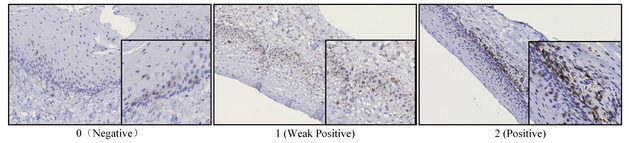
91.40%	0.88
ACCURACY (N=93)	AUC
95.83%	**0.95**
SENSITIVITY	F1 SCORE

Cross-validation & ROC Comparison



Pre-screening confusion matrix and ROC curves versus six otolaryngologists (manuscript Fig. 2)

Pathophysiological Support: CD3



Grade-2 CD3 positivity: 43.3% in LPR cases vs 25% in controls (p = 0.037)

Clinical Impact & Limitations

Clinical impact

- Manuscript reports performance comparable to chief-level otolaryngologists.
- Potential to shorten the LPR-CI diagnostic pathway and reduce invasive or prolonged testing.

Limitations / next steps

- Manual annotation noise can affect small-object training and segmentation.
- Further studies are needed to resolve discordant reference-standard cases and characterize disease progression.

CONCLUSION

BRSAR-CIVD integrates class-balanced segmentation and region self-attention to provide a rapid, automated endoscopic diagnosis of LPR-CI. Internal and external validation showed strong diagnostic performance, while CD3 staining provided complementary biological support.

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