



A deep learning based gastric section correlation network (GSCNet) could help predict the presence of corpus-predominant gastritis index (CGI) from endoscopic images without biopsy.



In-depth cooperation with NCKU Hospital

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Introduction:

1. The corpus-predominant gastritis index (CGI) has been shown an early and reversible marker to diagnose high gastric cancer risk before the presence of atrophy and intestinal metaplasia (IM)^{1,2} (Fig 1).
2. It was estimated that more than 90% of high gastric cancer risk patients could be screening out with the combination of CGI and IM3.
3. However, invasive biopsies and time-consuming pathological analysis are required for the diagnosis of CGI.
4. We composed a deep learning based gastric section correlation network (GSCNet) that could assess and compare gastric inflammation severities from endoscopic images of the antrum, corpus, and high corpus near cardia at the same time.

Aim:

To validate if GSCNet could help predict the presence of CGI from endoscopic images without biopsy.

Method:

1. Patients who received panendoscopy (EGD) studies and topographic biopsies according to the updated Sydney system protocols when clinical indicated were included. EGD images were also recorded topographically (Fig 2).
2. With training data from 212 patients' endoscopic images of antrum, body and high corpus near cardia, the deep learning based GSCNet learned representative features for different gastric sections by its scaling feature fusion model. Then with its section correlation module, the GSCNet computed features of different gastric sections to consider their correlations and achieved CGI diagnosis (Fig 3).
3. We enrolled 193 patients and upload their endoscopic images to a website linked to GSCNet. The accuracy of GSCNet for CGI prediction were assessed (Fig 4).

Conclusions:

The GSCNet is a potential tool to accurately predict the presence of CGI. It is worthy to further expand study cases and improve it.

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Results:

1. The GSCNet has good accuracy to predict the presence of CGI with the data listed in Table 1.
2. The area under ROC curve was 0.893, (p<0.001).
3. The GSCNet also have good accuracy to predict the presence of CGI in subpopulations of H. pylori-positive patients (N=43), H. pylori-negative patients (N=102), post H. pylori-eradication patients (N=48), and long-term proton pump inhibitor users (N=30) (Table 2).

Fig 1
The definition and topographic biopsy locations of the corpus predominant gastritis index (CGI).

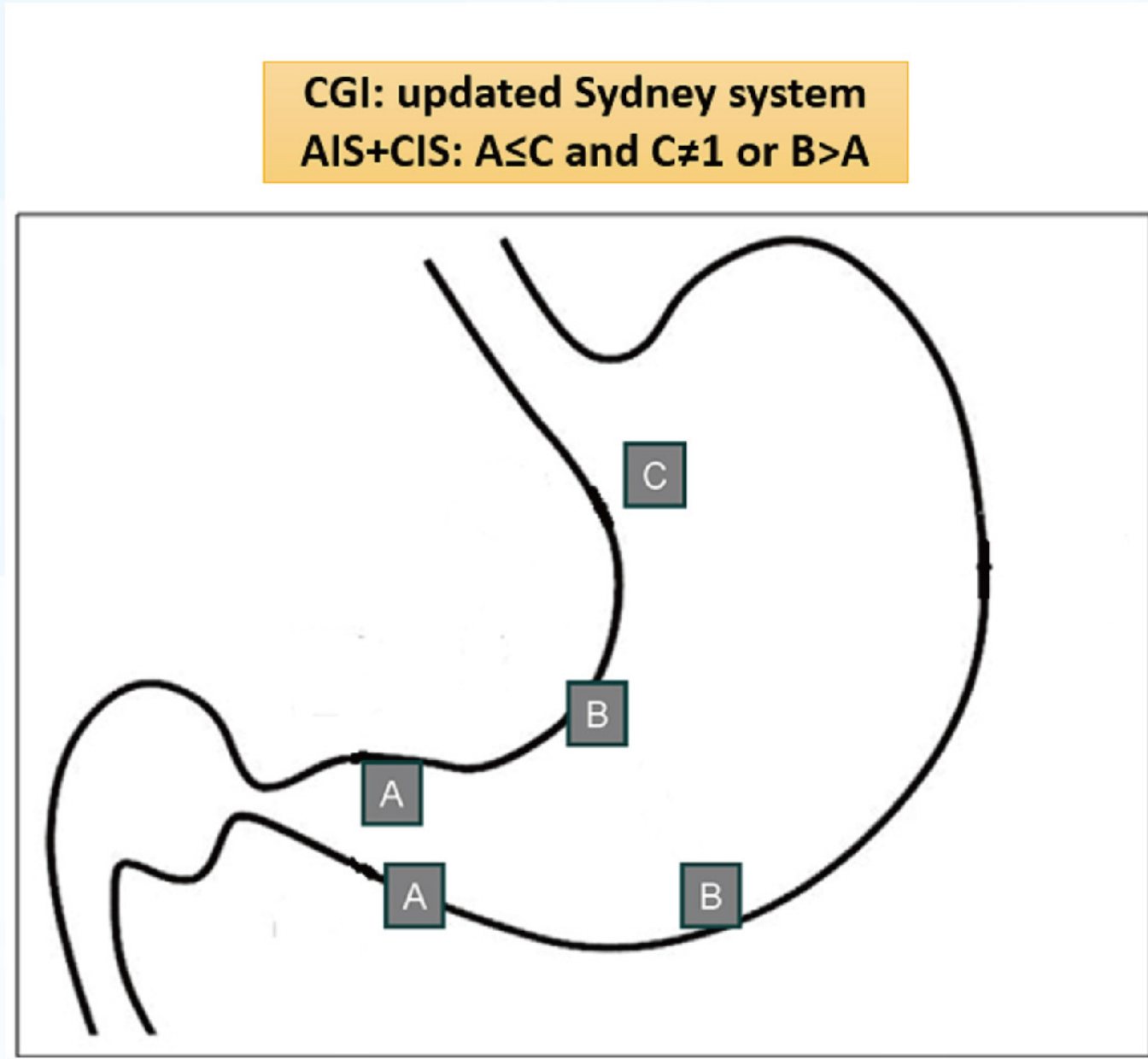


Fig 3
The overview of the gastric section correlation network (GSCNet) for the diagnosis of CGI.

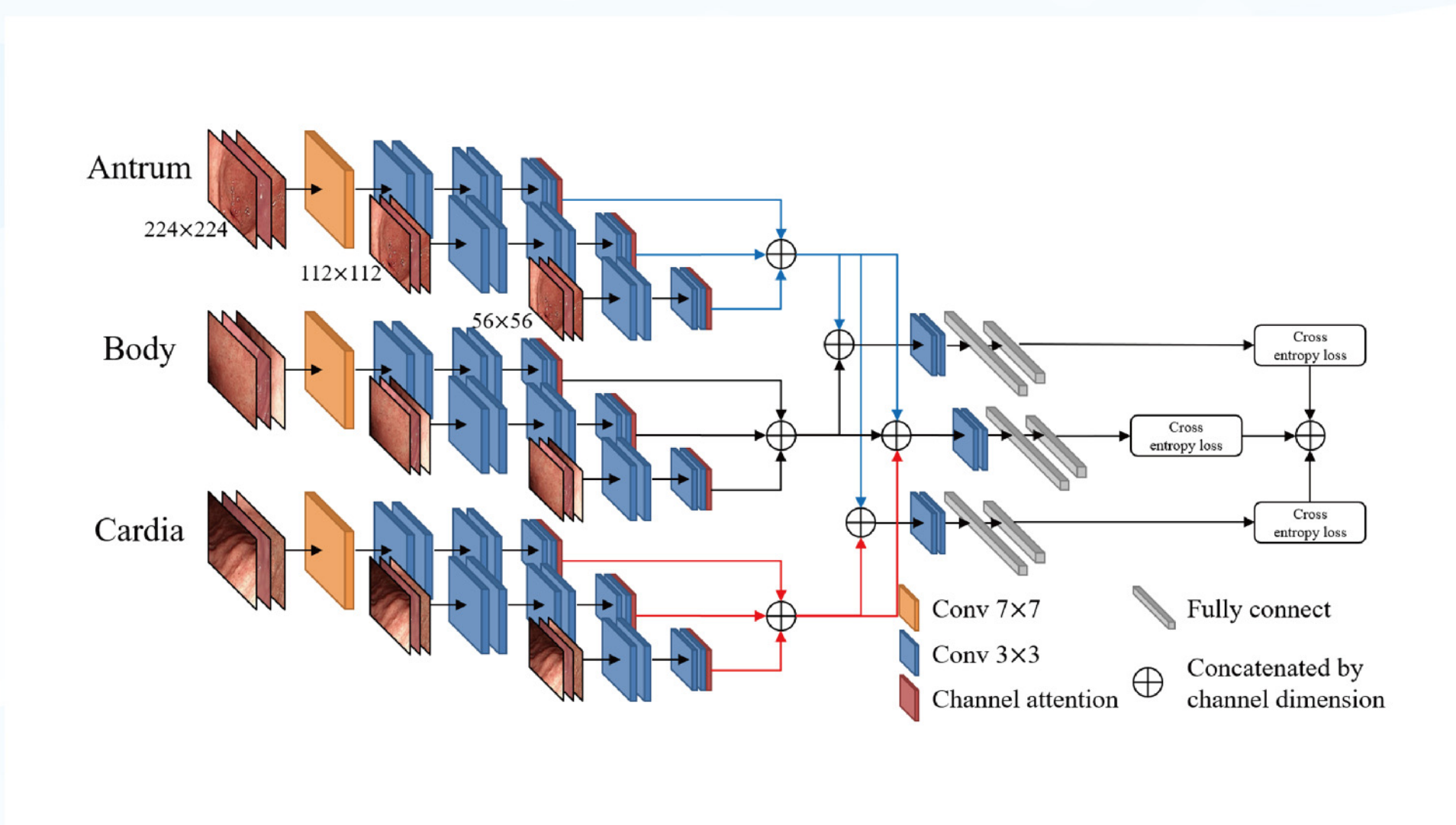


Fig 2
The protocol of the present study.

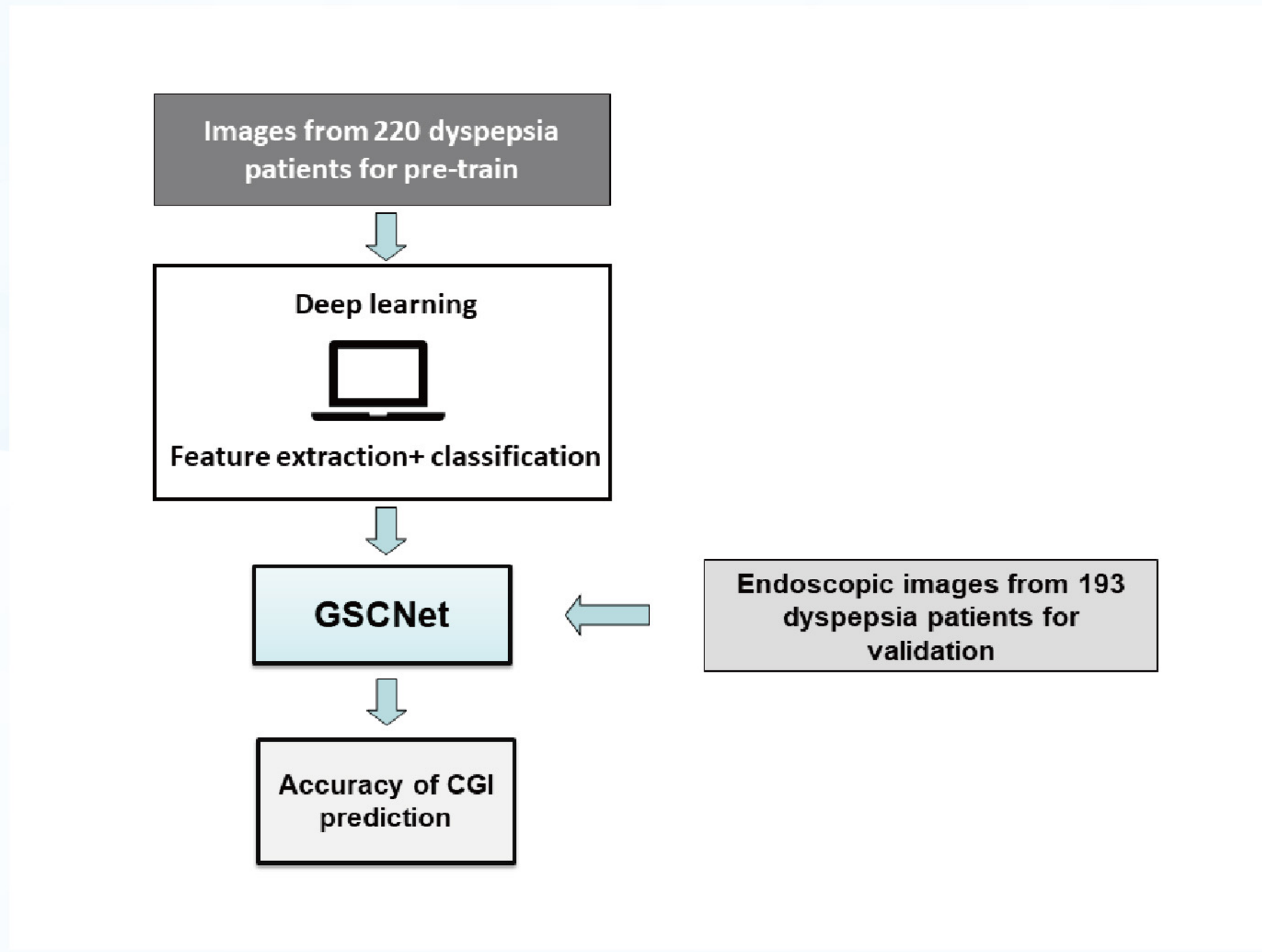


Fig 4
The web page we upload endoscopic images to computer-aid endoscopic diagnosis system GSCNet for the prediction of CGI.

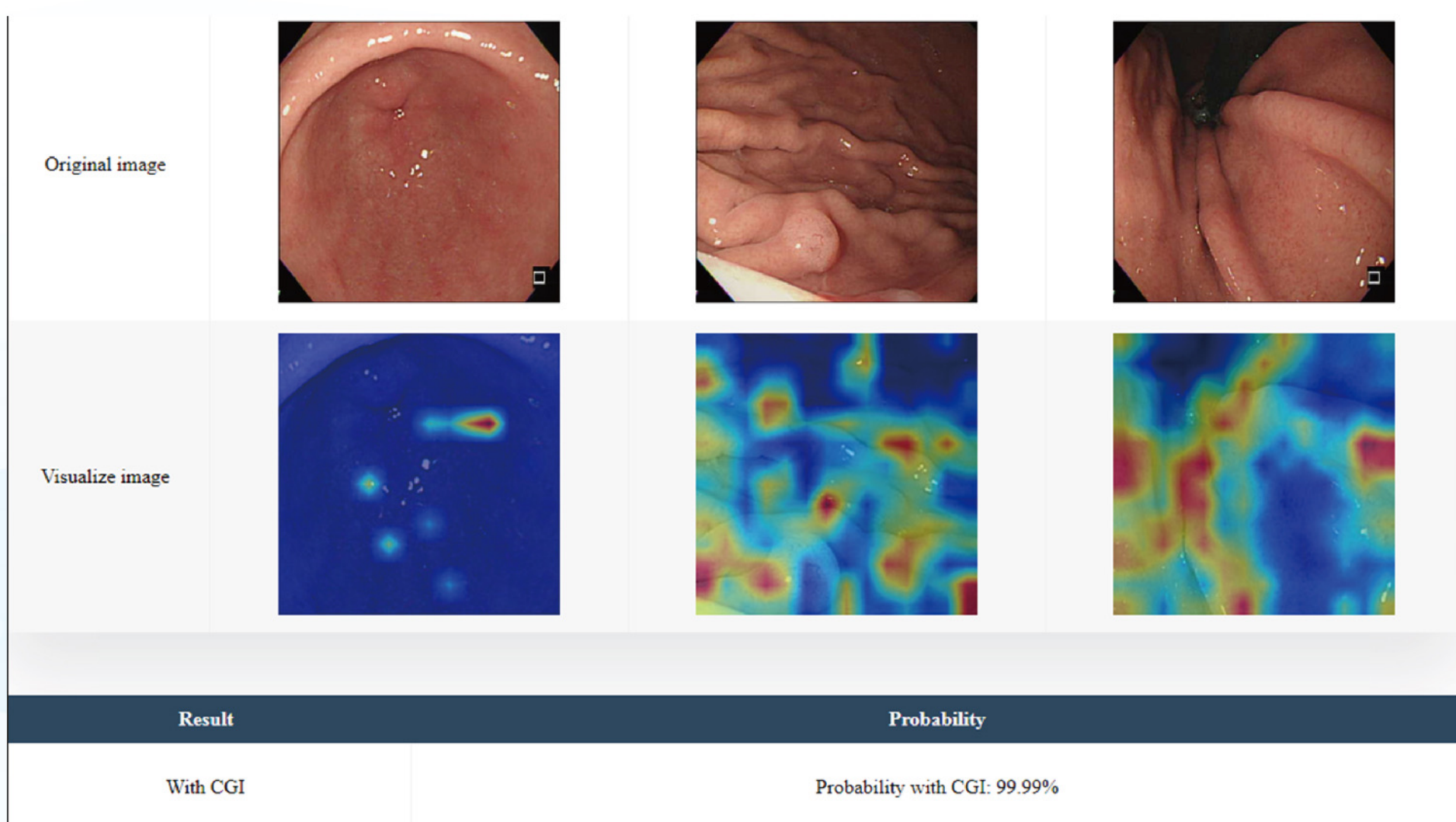


Table 1
The accuracy of GSCNet to predict the presence of CGI

NBI corpus mucosal pattern		CGI	
Statistics	Value	95% CI	
Sensitivity	83.64%	71.20%-92.23%	
Specificity	94.93%	89.83%-97.94%	
Positive likelihood ratio	16.49	7.94-34.26	
Negative likelihood ratio	0.17	0.09-0.31	
Disease prevalence	28.50%	22.25%-35.42%	
Positive predictive value	86.79%	75.98%-93.18%	
Negative predictive value	93.57%	88.89%-96.36%	
Accuracy	91.71%	86.89%-95.19%	

Table 2
The accuracies of GSCNet to predict the presence of CGI in subpopulation of patients with different clinical conditions. (Cases might be repeated in different subgroups.)

Subgroup	GSCNet	CGI	
Clinical history	Evaluation	Value	95% CI
H. pylori positive (N=43)	Sensitivity	90.48%	69.62%-98.83%
	Specificity	95.45%	77.16%-99.88%
	Positive predictive value	95.00%	73.58%-99.23%
	Negative predictive value	91.30%	73.69%-97.52%
	Accuracy	93.02%	80.94%-98.54%
	Disease prevalence	48.84%	33.31%-64.54%
H. pylori negative (N=102)	Sensitivity	71.43%	47.82%-88.72%
	Specificity	93.83%	86.18%-97.97%
	Positive predictive value	75.00%	55.17%-87.97%
	Negative predictive value	92.68%	86.53%-96.15%
	Accuracy	89.22%	81.52%-94.49%
	Disease prevalence	20.59%	13.22%-29.73%
Post H. pylori eradication (N=48)	Sensitivity	92.31%	63.97%-99.81%
	Specificity	97.14%	85.08%-99.93%
	Positive predictive value	92.31%	63.34%-98.81%
	Negative predictive value	97.14%	83.79%-99.55%
	Accuracy	95.83%	85.75%-99.49%
	Disease prevalence	27.08%	15.28%-41.85%
Long-term PPIs users (N=30)	Sensitivity	100.00%	47.82%-100.00%
	Specificity	96.00%	79.65%-99.90%
	Positive predictive value	83.33%	42.29%-97.15%
	Negative predictive value	100.00%	0 false negative
	Accuracy	96.67%	82.78%-99.92%
	Disease prevalence	16.67%	5.64%-34.72%