

Supplementary Table 1 Comparison of each item of Eckardt Scores and CARS Scores in different intensity of anti-enteric neuronal antibodies

	AENA negative (N = 38)	AENA positive (N = 59)	P	AENA moderate positive (N = 37)	AENA strong positive (N = 22)	P
Eckardt Scores						
Dysphagia, n (%)			0.146			0.270
occasionally	2 (5.3)	1 (1.7)		0 (0.0)	1 (4.5)	
daily	5 (13.2)	4 (6.8)		2 (5.4)	2 (9.1)	
per meal	31 (81.6)	54 (91.5)		35 (94.6)	19 (86.4)	
Reflux, n (%)			0.843			0.319
absent	3 (7.9)	5 (8.5)		3 (8.1)	2 (9.1)	
occasionally	16 (42.1)	23 (39.0)		12 (32.4)	11 (50.0)	
daily	10 (26.3)	16 (27.1)		12 (32.4)	4 (18.2)	
per meal	9 (23.7)	15 (25.4)		10 (27.0)	5 (22.7)	
Chest Pain, n (%)			0.149			0.451
absent	16 (42.1)	33 (55.9)		20 (54.1)	13 (59.1)	
occasionally	16 (42.1)	21 (35.6)		12 (32.4)	9 (40.9)	
daily	4 (10.5)	3 (5.1)		3 (8.1)	0 (0.0)	
per meal	2 (5.3)	2 (3.4)		2 (5.4)	0 (0.0)	
Weight loss, n (%)			0.876			0.448
no weight loss	11 (28.9)	18 (30.5)		11 (29.7)	7 (31.8)	
<5.0 kg	12 (31.6)	10 (16.9)		8 (21.6)	2 (9.1)	
5.0~10.0 kg	5 (13.2)	20 (33.9)		13 (35.1)	7 (31.8)	
>10.0 kg	10 (26.3)	11 (18.6)		5 (13.5)	6 (27.3)	

Note: Data were presented by number (percentage). Mann–Whitney U-test.

Abbreviations: AENA, anti-enteric neuronal antibodies.

Supplementary Table 2 Baseline characteristics before and after overlap weighting

Baseline Characteristics	After ATO Weighting		
	AENA negative (n=9.01)	AENA positive (n=9.01)	SMD
Age, median [IQR], years	36.83 [34.00, 51.88]	43.06 [34.00, 48.30]	<0.001
Female sex, n (%)	6.0 (67.1%)	6.0 (67.1%)	<0.001
Disease duration, median (IQR), yr	3.41 [1.66, 9.00]	3.00 [1.19, 4.10]	<0.001
Baseline Eckardt score, median [IQR]	7.00 [5.00, 9.00]	6.60 [6.00, 8.00]	<0.001
CARS score, median [IQR]	5.00 [3.00, 5.00]	4.64 [3.00, 5.00]	<0.001

SMD, standardized mean difference. ATO, average treatment effect on the overlap population. SMD <0.1 indicates adequate covariate balance.

Supplementary Table 3 Sensitivity analyses after exclusion of patients with autoimmune comorbidities (*n* = 93)

Variable	Primary analysis (n=97) β (95% CI)	<i>P</i>	Sensitivity analysis (n=93) β (95% CI)	<i>P</i>
AENA intensity (ref: negative)				
Moderate-positive	0.08 (−0.65, 0.80)	0.838	−0.02 (−0.77, 0.74)	0.965
Strong-positive	0.95 (0.37, 1.53)	0.002	0.94 (0.37, 1.52)	0.002
Age, per year	0.00 (−0.02, 0.02)	0.851	0.00 (−0.02, 0.02)	0.773
Sex (male vs female)	0.15 (−0.41, 0.71)	0.596	0.09 (−0.49, 0.67)	0.749
Disease duration, per year	0.00 (−0.04, 0.04)	0.943	0.00 (−0.04, 0.04)	0.941
AC subtype	−0.06 (−0.64, 0.52)	0.841	−0.04 (−0.63, 0.55)	0.897
AENA intensity (ordinal, per category)	0.43 (0.14, 0.73)	0.005	0.43 (0.14, 0.72)	0.006

Outcomes	Primary analysis AENA negative (n=18)	Primary analysis AENA positive (n=23)	<i>P</i> -value	Sensitivity analysis AENA- (n≈8.9)	<i>P</i> -value
1-month follow-up					
Eckardt score, median [IQR]	0.00 [0.00, 1.00]	1.00 [0.58, 2.00]	0.031	0.00 [0.00, 1.00]	0.042
Δ Eckardt score, median [IQR]	6.00 [5.00, 7.31]	4.68 [4.00, 6.48]	0.173	6.00 [5.00, 7.11]	0.186
6-month follow-up					
Eckardt score, median [IQR]	0.00 [0.00, 1.00]	1.00 [1.00, 2.00]	0.005	0.00 [0.00, 1.00]	0.009
Δ Eckardt score, median [IQR]	5.51 [4.00, 9.00]	5.00 [4.00, 6.20]	0.233	5.30 [4.00, 9.00]	0.293
CARS score, median [IQR]	1.00 [1.00, 1.43]	1.00 [1.00, 2.05]	0.915	1.00 [1.00, 1.46]	0.931
IRP, median [IQR], mmHg	1.99 [0.69, 4.38]	2.36 [0.67, 5.00]	0.840	2.00 [0.77, 4.22]	0.836
Barium width, median [IQR], mm	25.10 [11.00, 30.00]	22.84 [15.39, 36.55]	0.674	25.31 [11.26, 30.00]	0.684

Sensitivity analysis excluded 4 patients with pre-existing autoimmune comorbidities. Part A: β coefficients with 95% CI from multivariable linear regression (HC3 robust SE), adjusted for age, sex, disease duration, and AC subtype. Part B: ATO-weighted comparisons using weighted non-parametric tests. Δ, change from baseline. ATO, average treatment effect on the overlap population; CARS, Chicago Achalasia Rating Scale; IRP, integrated relaxation pressure.