

Table 1 Demographics and general information of NEC patients

Characteristics	Training cohort (n = 128)				Validation cohort (n = 52)				P [#]
	Total (128)	Perforation (n = 34)	Non-Perforation (n = 94)	P value	Total (52)	Perforation (n = 14)	Non-Perforation (n = 38)	P value	
Gender	—	—	—	0.407	—	—	—	0.371	0.148
Male	79 (61.7)	23 (67.6)	56 (59.6)	—	38 (73.1)	12 (85.7)	26 (68.4)	—	—
Female	49 (38.3)	11 (32.4)	38 (40.4)	—	14 (26.9)	2 (14.3)	12 (31.6)	—	—
Age at onset (days)	—	—	—	0.113	—	—	—	0.588	0.488
≤ 14	92 (71.9)	28 (82.4)	64 (68.1)	—	40 (76.9)	12 (85.7)	28 (73.7)	—	—
> 14	36 (28.1)	6 (17.6)	30 (31.9)	—	12 (23.1)	2 (14.3)	10 (26.3)	—	—
Season	—	—	—	0.058	—	—	—	0.085	0.697
Spring	33 (25.8)	11 (32.4)	22 (23.4)	—	18 (34.6)	2 (14.3)	16 (42.1)	—	—
Summer	29 (22.7)	12 (35.3)	17 (18.1)	—	11 (21.2)	5 (35.7)	6 (15.8)	—	—
Autumn	38 (29.7)	7 (20.6)	31 (33.0)	—	13 (25.0)	4 (28.6)	9 (23.7)	—	—
Winter	28 (21.8)	4 (11.7)	24 (25.5)	—	10 (19.2)	3 (21.4)	7 (18.4)	—	—
Gestational age	—	—	—	0.502	—	—	—	0.118	0.378
≥ 37 weeks	51 (39.8)	11 (32.4)	40 (42.6)	—	25 (48.1)	4 (28.6)	21 (55.3)	—	—
32-37 weeks	37 (28.9)	10 (29.4)	27 (28.7)	—	10 (19.2)	5 (35.7)	5 (13.2)	—	—
≤ 32 weeks	40 (31.3)	13 (38.2)	27 (28.7)	—	17 (32.7)	5 (35.7)	12 (31.5)	—	—
Weight(g)	—	—	—	<0.001	—	—	—	0.949	0.014
> 1500	82 (64.1)	10 (29.4)	72 (76.6)	—	43 (82.7)	11 (78.6)	32 (84.2)	—	—
≤ 1500	46 (35.9)	24 (70.6)	22 (23.4)	—	9 (17.3)	3 (21.4)	6 (15.8)	—	—
Delivery way	—	—	—	0.262	—	—	—	0.532	0.775
Natural	61 (47.7)	19 (55.8)	42 (44.7)	—	26 (50.0)	8 (57.1)	18 (47.4)	—	—
Cesarean	67 (52.3)	15 (44.2)	52 (55.3)	—	26 (50.0)	6 (42.9)	20 (52.6)	—	—
Feeding way	—	—	—	0.442	—	—	—	1.000	0.059
Breast milk	21 (16.4)	7 (20.6)	14 (14.9)	—	15 (28.8)	4 (28.6)	11 (28.9)	—	—
Formula milk	107 (83.6)	27 (79.4)	80 (85.1)	—	37 (71.2)	10 (71.4)	27 (71.1)	—	—

[#]Comparison between the training and validation cohort variables

Table 2 Clinical characteristics and laboratory findings of NEC patients

Characteristics	Training cohort (n = 128)				Validation cohort (n = 52)				
	Total (n = 128)	Perforation (n = 34)	Non-Perforation (n = 94)	P value	Total (n = 52)	Perforation (n = 14)	Non-Perforation (n = 38)	P value	P [#]
Pneumonia	74 (57.8)	23 (67.6)	51 (54.3)	0.195	29 (55.8)	10 (71.4)	19 (50)	0.168	0.802
Respiratory failure	42 (32.8)	13 (38.2)	29 (30.9)	0.432	12 (23.1)	4 (28.6)	8 (21.1)	0.842	0.196
Pulmonary hemorrhage	3 (2.3)	1 (2.9)	2 (2.1)	1.000	1 (1.9)	1 (7.1)	0 (0)	0.269	1.000
Bloody stool	31 (24.2)	16 (47.1)	15 (16.0)	< 0.001	17 (32.7)	7 (50)	10 (26.3)	0.200	0.244
Metabolic acidosis	26 (20.3)	10 (29.4)	16 (17.0)	0.124	10 (19.2)	3 (21.4)	7 (18.4)	1.000	0.869
Hemolysis	61 (47.7)	14 (41.2)	47 (50)	0.377	22 (42.3)	5 (35.7)	17 (44.7)	0.559	0.514
Septicemia	52 (40.6)	15 (44.1)	37 (39.4)	0.628	29 (55.8)	7 (50)	22 (57.9)	0.611	0.064
Anemia	65 (50.8)	18 (52.9)	47 (50)	0.769	28 (53.8)	10 (71.4)	18 (47.4)	0.123	0.709
Electrolyte disturbance	62 (48.4)	21 (61.8)	41 (43.6)	0.070	26 (50)	8 (57.1)	18 (47.4)	0.532	0.849
Peritonitis	30 (23.4)	14 (41.2)	16 (17.0)	0.004	11 (21.2)	7 (50.0)	4 (10.5)	0.002	0.741
Shock	24 (18.8)	8 (23.5)	16 (17.0)	0.405	10 (19.2)	4 (28.6)	6 (15.8)	0.522	0.940
Thrombocytopenia	22 (17.2)	14 (41.2)	8 (8.5)	<0.001	7 (13.5)	5 (35.7)	2 (5.3)	0.004	0.538
Hypoglycemia	17 (13.3)	6 (17.6)	11 (11.7)	0.381	6 (11.5)	2 (14.3)	4 (10.5)	1.000	0.751
Cholestasis	9 (7.0)	1 (2.9)	8 (8.5)	0.486	3 (5.8)	1 (7.1)	2 (5.3)	1.000	1.000
Hypoalbuminemia	36 (28.1)	18 (52.9)	18 (19.1)	<0.001	10 (19.2)	5 (35.7)	5 (13.2)	0.152	0.215
Invasive ventilation	15 (11.7)	5 (14.7)	10 (10.6)	0.748	5 (9.6)	4 (28.6)	1 (2.6)	0.022	0.684
Non-invasive ventilation	22 (17.2)	6 (17.6)	16 (17.0)	0.934	13 (25)	4 (28.6)	9 (23.7)	1.000	0.230
Breath stimulants	20 (15.6)	6 (17.6)	14 (14.9)	0.705	6 (11.5)	2 (14.3)	4 (10.5)	1.000	0.480
Blood transfusion	15 (11.7)	9 (26.5)	6 (6.4)	0.002	7 (13.5)	4 (28.6)	3 (7.9)	0.139	0.746
Apply antibiotics	33 (25.8)	9 (26.5)	24 (25.5)	0.915	15 (28.8)	5 (35.7)	10 (26.3)	0.750	0.000
WBC	11.2 (7.9, 16.4)	13.8 (9.7, 20.6)	10.4 (7.6, 15.5)	0.016	10.5 (7.2, 15.2)	14.1 (5.8, 17.4)	10.3 (7.4, 13.8)	0.470	0.456
WBC $\geq 15 \times 10^9/L$	40 (31.3)	15 (44.1)	25 (26.6)	0.059	14 (26.9)	7 (50.0)	7 (18.4)	0.023	0.566
ANC	6.6 (4.2, 10.1)	8.6 (5.6, 14.3)	6.1 (4.1, 9.2)	0.009	6.9 (4.1, 10.8)	8.5 (4.0, 13.4)	6.5 (4.1, 9.7)	0.369	0.897
ANC $\geq 10 \times 10^9/L$	33 (25.8)	16 (47.1)	17 (18.1)	0.001	15 (28.8)	6 (42.9)	9 (23.7)	0.313	0.673
LYM	2.3 (1.5, 3.6)	2.0 (1.2, 3.9)	2.4 (1.5, 3.6)	0.478	2.1 (1.2, 3.0)	2.1 (1.0, 2.9)	2.1 (1.3, 3.1)	0.781	0.170
MO	1.2 (0.8, 2.1)	1.4 (0.7, 2.5)	1.1 (0.8, 1.7)	0.234	1.2 (0.7, 1.6)	1.4 (0.7, 2.7)	1.2 (0.8, 1.6)	0.789	0.704
HB	144.1 $\pm$ 33.1	141.5 $\pm$ 35.0	145.0 $\pm$ 32.6	0.593	144.5 $\pm$ 32.9	131.2 $\pm$ 25.1	149.3 $\pm$ 34.3	0.077	0.946
RDW	16.1 (15.2, 17.1)	16.2 (15.5, 17.0)	16.0 (15.1, 17.1)	0.686	16.1 (15.2, 17.2)	16.3 (15.3, 18.4)	16.1 (15.1, 17.1)	0.509	0.781
ALT	10 (8, 17)	11 (8, 19)	10 (7, 17)	0.912	11 (7.3, 17.3)	13 (10, 27)	10 (7, 15)	0.073	0.891
AST	41 (27, 60)	49 (27, 64)	37 (27, 60)	0.167	43 (30, 72)	74 (28, 117)	40 (29, 55)	0.078	0.662
AKP	206 (141, 294)	192 (117, 247)	215 (146, 302)	0.104	173 (137, 260)	189 (140, 354)	167 (134, 249)	0.375	0.385
TBIL	132.2 (100.8, 186.9)	115.8 (99.6, 180.8)	138 (102, 189)	0.366	141.1 (90.7, 199.4)	147.3 (72.4, 241.3)	141 (97, 198)	0.845	0.418
CK	199 (109, 342)	220 (158, 347)	186 (101, 342)	0.358	237 (112, 451)	230 (129, 597)	241 (106, 426)	0.726	0.467
CK-MB	36 (24, 63)	48 (27, 79)	33 (23, 54)	0.031	50 (25, 100)	96 (49.5, 148)	37 (23, 68)	0.016	0.100
CK-MB $\geq 50 U/L$	40 (31.3)	15 (44.1)	25 (26.6)	0.059	26 (50)	11 (78.6)	15 (39.5)	0.012	0.018
LDH	453 (327, 569)	494 (371, 588)	428 (323, 568)	0.146	510 (371, 701)	631 (431, 813)	475 (319, 599)	0.018	0.200
PAB	72 (50, 88)	71 (49, 86)	73 (51, 95)	0.335	65 (49, 84)	63 (44, 83)	65 (50, 85)	0.592	0.402
Cr	41 (30, 51)	43 (34, 54)	38 (28, 51)	0.182	48 (37, 62)	48 (42, 67)	47.5 (36.0, 60.8)	0.433	0.013
PT	15.5 (12.9, 17.8)	15.7 (13.9, 17.8)	15.5 (12.8, 17.8)	0.432	14.6 (12.9, 17.8)	17.7 (14.5, 20.0)	13.9 (12.5, 15.9)	0.009	0.428
APTT	47.2 (39.2, 60.9)	55.5 (42.4, 67.0)	45.5 (38.3, 56.2)	0.039	52.5 (43.6, 60.5)	57.1 (48.3, 61.3)	47.3 (42.6, 60.6)	0.216	0.253
$\geq 50s$	58 (45.3)	22 (64.7)	36 (38.3)	0.011	27 (51.9)	10 (71.4)	17 (44.7)	0.087	0.421

[#]Comparison between the training and validation cohort variables

The normal range of test indicators: WBC (4-10 $\times$ 10⁹/L), ANC (2.5-7.5 $\times$ 10⁹/L), CK-MB (< 25 U/L), APTT (31 - 40 s).

ANC = Absolute neutrophil count, LYM = Lymphocyte absolute value, MO = Monocyte absolute value, RDW = Red blood cell distribution width, Haemoglobin = HB, ALT = Alanine Aminotransferase, AST = Aspartate aminotransferase, AKP = Alkaline phosphatase, TBIL = Total bilirubin, CK = Creatine kinase, CK-MB = creatine kinase isoenzyme, LDH = Lactate dehydrogenase, PAB = Prealbumin, Cr = Creatinine, PT = Prothrombin time, APTT = Activated partial thromboplastin time.

Table 3 Risk factors related to perforation in the training cohort

Characteristics	Univariable OR (95% CI)	<i>P</i> value	Multivariable OR (95% CI)	<i>P</i> value
Weight (g)	—	—	—	—
>1500	1 (ref)	—	—	—
≤ 1500	1.36 (0.57, 3.28)	0.489	—	—
Bloody stool	4.68 (1.96, 11.18)	0.001	5.60 (1.92, 16.33)	0.002
Peritonitis	3.41 (1.43, 8.14)	0.006	—	—
Thrombocytopenia	7.53 (2.78, 20.37)	<0.001	4.74 (1.52, 14.81)	0.007
Hypoalbuminemia	4.75 (2.04, 11.08)	<0.001	5.56 (1.95, 15.82)	0.001
ANC	—	—	—	—
< 10×10 ⁹ /L	1 (ref)	—	—	—
≤ 10×10 ⁹ /L	4.03 (1.71, 9.46)	0.001	—	—
APTT	—	—	—	—
< 50s	1 (ref)	—	—	—
≥ 50s	2.95 (1.31, 6.69)	0.009	3.22 (1.21, 8.61)	0.019
Blood transfusion	5.28 (1.72, 16.26)	0.004	—	—

ANC=Absolute neutrophil count.