

INTRODUCTION

Neonatal seizures are linked to:

- A high mortality rate (however it has reduced in recent years)
- Long-term neurodevelopmental disabilities, intellectual impairments, cerebral palsy, and epilepsy

OBJECTIVES

- To determine the predictive value of a set of independent risk factors for neurological outcomes in a well etiology-defined cohort
- To design a new scoring model for infants with seizures in the neonatal intensive care unit (NICU)

MATERIAL & METHODS

- 79 neonates (preterm: 54, 68.4%, term: 25, 31.6%)
- Outcomes evaluated with The Ankara Developmental Screening Inventory (ADSI)
 - **Overall outcome:** included all living and deceased infants
 - **Functional neurodevelopmental outcome:** only included infants who survived up to one-year of age
- Univariate statistical analysis method identified significant variables associated with poor/adverse outcomes
- Each independent risk factors for the poor/adverse outcomes was scored from 0 to 3
- According to etiology, two separate scoring systems were developed
 - **ENOSS-1;** epileptogenesis-based neonatal seizure scoring system
 - **ENOSS-2;** etiology-based neonatal seizure scoring system

Table 1: Evidence-based independent risk factors for overall outcomes and functional neurodevelopmental outcomes in preterm and term neonates with neonatal seizures

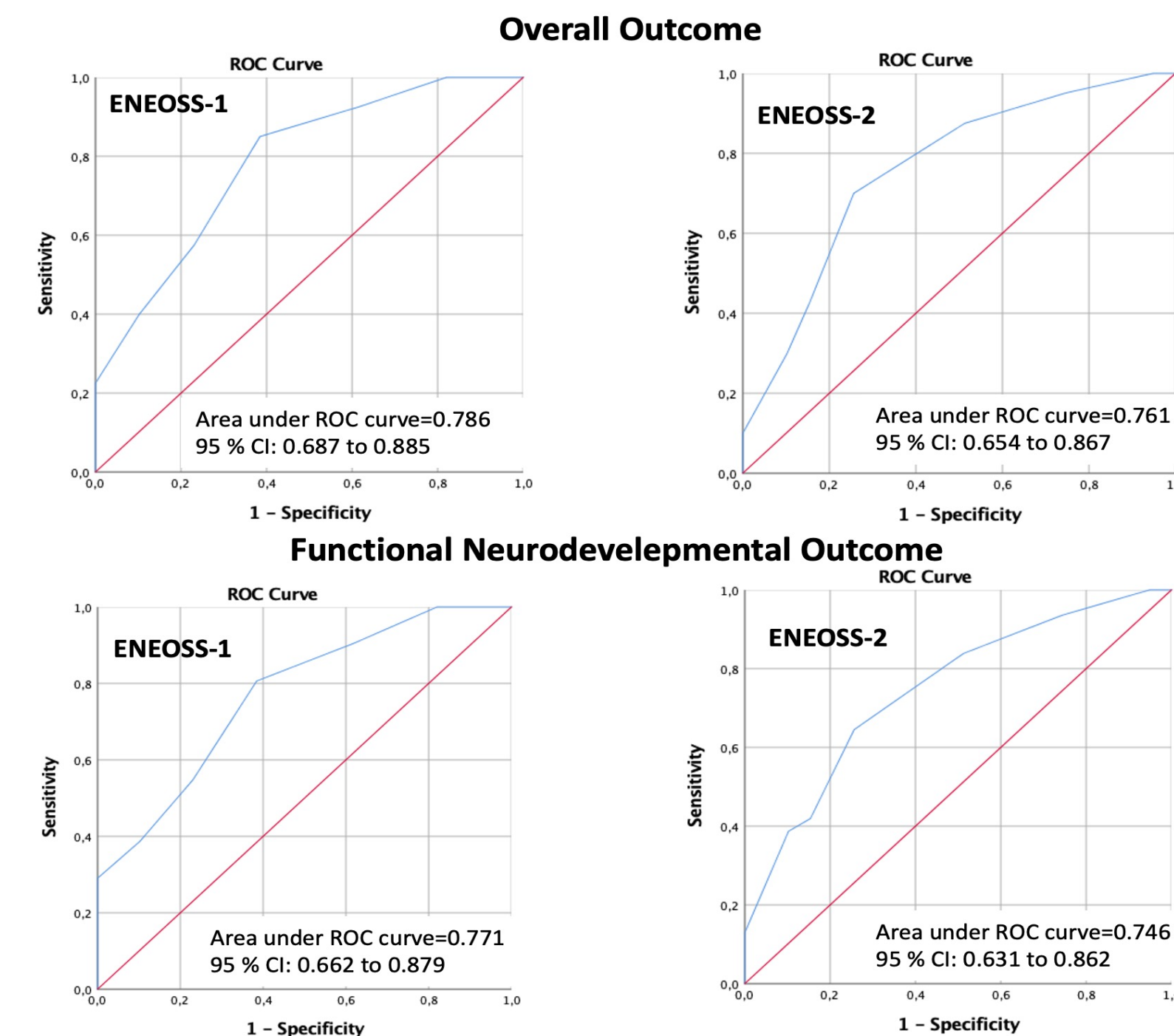
Variables	Overall outcome ♦ * n: 79			Functional neurodevelopmental outcome* n: 70			
	Good n:39, 49.3%	Poor n:40, 50.6%	P	Favorable n:39, 55.7%	Adverse n:31, 44.3%	p	
Type of delivery	Spontaneous	7, 17.9%	9, 22.5%	0.615	7, 17.9%	8, 25.8%	0.426
	Cesarian delivery	32, 82.1%	31, 77.5%		32, 82.1%	23, 74.2%	
Gender	female	17, 43.6%	16, 40%	0.746	17, 43.6%	11, 35.5%	0.492
	Male	22, 56.4%	24, 60%		22, 56.4%	20, 64.5%	
Gestational age (weeks)	<29	14, 35.9%	12, 30%	0.025	14, 35.9%	11, 35.5%	0.094
	29-33	14, 35.9%	5, 12.5%		14, 35.9%	4, 12.9%	
	34-36	4, 10.3%	5, 12.5%		4, 10.3%	4, 12.9%	
	>37	7, 17.9%	18, 45%		7, 17.9%	12, 38.7%	
Birth weight, (gr)	<1000	12, 30.8%	8, 20%	0.007	12, 30.8%	7, 22.6%	0.049
	1000-1499	9, 23.1%	3, 7.5%		9, 23.1%	3, 9.7%	
	1500-2499	10, 25.6%	6, 15%		10, 25.6%	5, 16.1%	
	>2500	8, 20.5%	23, 57.5%		8, 20.5%	16, 51.6%	
APGAR score at 1 min	0-3	4, 10.3%	6, 15%	0.562	4, 10.3%	4, 12.9%	0.688
	4-7	27, 69.2%	29, 72.5%		27, 69.2%	23, 74.2%	
	8-10	8, 20.5%	5, 12.5%		8, 20.5%	4, 12.9%	
APGAR score at 5 min	0-3	2, 5.1%	-	0.311	2, 5.1%	-	0.273
	4-7	5, 12.8%	7, 17.5%		5, 12.8%	7, 22.6%	
	8-10	32, 82.1%	33, 82.5%		32, 82.1%	24, 77.4%	
Etiology group 1 (Epileptogenesis-based)	Acute-provoked	29, 74.4%	24, 60%	<0.001	29, 74.4%	19, 61.3%	<0.001
	Unprovoked	/	14, 35%		/	10, 32.3%	
	Unknown	10, 25.6%	2, 5%		10, 25.6%	2, 6.5%	
Etiology group 2 (Etiology-based)	Favorable	26, 66.7%	16, 40%	0.018	26, 66.7%	13, 41.9%	0.039
	Unfavorable	13, 33.3%	24, 60%		13, 33.3%	18, 58.1%	
Onset time of seizure, hour	<48	8, 21.6%	4, 10.8%	0.345	8, 21.6%	3, 9.7%	0.208
	>48	29, 78.4%	33, 89.2%		29, 78.4%	28, 90.3%	
Volpe's seizure classification	Subtle	14, 37.8%	16, 43.3%	0.926	14, 37.8%	14, 45.2%	0.510
	Tonic	5, 13.5%	5, 13.5%		5, 13.5%	5, 16.1%	
	Myoclonic	11, 29.7%	11, 29.7%		11, 29.7%	10, 32.3%	
	Clonic	7, 18.9%	5, 13.5%		7, 18.9%	2, 6.5%	
Ultrasound brain scan	Normal	20, 52.6%	7, 19.4%	0.003	20, 52.6%	5, 18.5%	0.009
	Abnormal	18, 47.4%	29, 80.6%		18, 47.4%	22, 81.5%	
MRI findings	Normal	15, 44.1%	3, 8.3%	0.003	15, 44.1%	2, 7.1%	0.005
	IVH grades 1-2	8, 23.5%	15, 41.7%		8, 23.5%	10, 35.7%	
	Parenchymal damage, brain malformation	11, 32.4%	18, 50%		11, 32.4%	16, 57.1%	
EEG background grades	Grade 0-1	33, 89.2%	23, 67.6%	0.026	33, 89.2%	19, 67.9%	0.035
	Grade 2-3	4, 10.8%	11, 32.4%		4, 10.8%	9, 32.1%	
Drug refractory seizures	Present	18, 81.8%	25, 83.3%	0.585	18, 81.8%	25, 83.3%	0.585
	Absent	4, 18.2%	5, 16.7%		4, 18.2%	5, 16.7%	

♦ Nine neonates died in the NICU, * Evaluated with The Ankara Developmental Screening Inventory (ADSI)

RESULTS

The best forecast for the poor overall outcome was a score of 3.5 (ROC area undercurve: 78.6), with a specificity of 85% and a negative predictive value of 69.3% (Figure 1, Table 2).

Figure 1. Receiver Operating Characteristic (ROC) Curves of ENEOSS for poor and adverse outcome



CONCLUSIONS

We defined four predominant clinical predictors for adverse outcomes in infants with clinical neonatal seizures:

- Birth weight
- Etiology
- Neuroimaging
- EEG background grades

The model-ENE OSS is a practical and reliable new tool for adverse/poor outcomes in infants

Table 2: The predictive values of scoring models for poor and adverse outcomes in infants with neonatal seizures

Scoring models for neonatal seizures	AUC	Cut-off value	Sensitivity	Specificity	PPV	NPV
Pisani et al. I., 2009	0.919	5	0.814	0.833	0.905	0.698
Garfinkle et al., 2011	0.876	3	0.811	0.840	0.843	0.808
ENE OSS-1, 2022						
For overall outcome	0.786	3.5	0.615	0.850	0.800	0.693
For functional neurodevelopmental outcome	0.771	3.5	0.806	0.615	0.625	0.800
ENE OSS-2, 2022						
For overall outcome	0.761	3.5	0.736	0.707	0.700	0.743
For functional neurodevelopmental outcome	0.746	3.5	0.645	0.743	0.666	0.725

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