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INTRODUCTION

Minimal hepatic encephalopathy (HE)

- More than 1/3 of cirrhotic patients suffer minimal HE in Korea.
- Poor prognostic implications
- Without clinical manifestations
- Abnormal results of psychometric or neurophysiological tests

AIM

We aimed to validate effectiveness of mobile Korean stroop (K-stroop) test in the screening of minimal HE.

METHOD I

Prospective, Multi-center, Cohort study
2016.1 – 2017.12

Chronic hepatitis B related LC (N=223)

Inclusion

- Adults aged less than or equal to 65 years

Exclusion

- Previous history of overt HE
- Significant alcohol intake
- Taking neurologic or psychologic medications
- Systemic infection within 6 weeks
- GI bleeding within 6 weeks
- Viable HCC or other malignancies

PHEs (MHE < -4) & K-stroop test

Healthy controls (HC) (N=376)

Inclusion

- Adults aged less than or equal to 65 years

Exclusion

- Uncontrolled chronic disease with medications
- Suspicious symptoms or history of dementia
- Taking neurologic or psychologic medications
- Significant alcohol intake
- Color blindness

K-stroop test

RESULTS

1. Baseline characteristics

	Healthy controls (n = 376)	LC without MHE (n = 177)	LC with MHE (n = 46)
Male	190 (50.6%)	125 (70.6%)*	25 (54.3%) [‡]
Age (years)	43 ± 14	53 ± 8*	55 ± 7 [†]
Education (years)	14 ± 3	12 ± 3*	10 ± 3 [‡]
Platelets (×10 ³ /uL)	-	124 ± 56	110 ± 53
Prothrombin time (INR)	-	1.18 ± 0.22	1.21 ± 0.20
Albumin (g/L)	-	4.2 ± 0.5	3.9 ± 0.6 [‡]
Total bilirubin (mg/dL)	-	1.2 ± 0.9	1.4 ± 1.2
Sodium (mEq/L)	-	140 ± 3	139 ± 4
Ammonia (mmol/L)	-	100 ± 61	91 ± 45
MELD	-	6 ± 4	7 ± 4

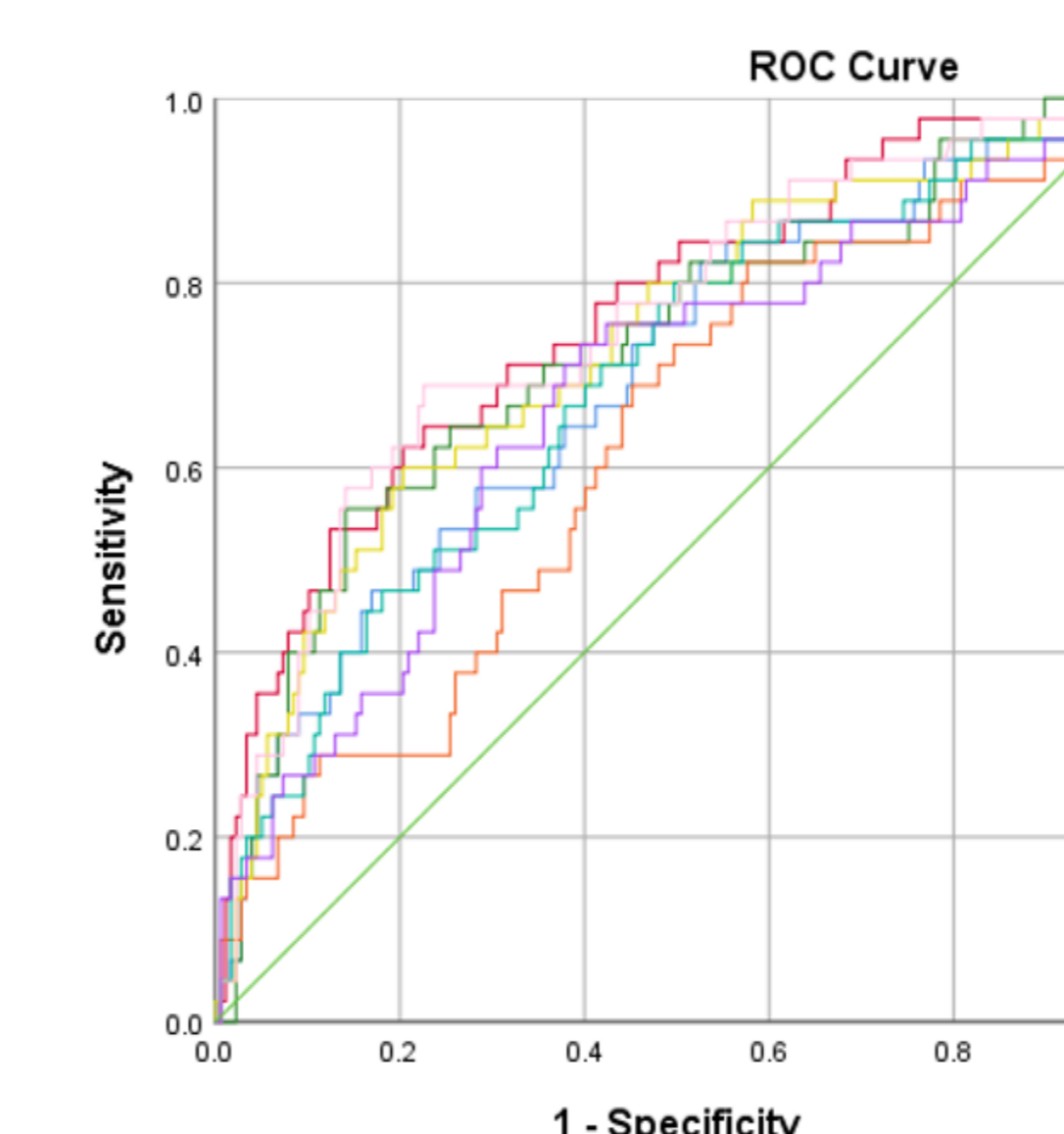
* HCs vs. LC without minimal HE; [†] HCs vs. LC with minimal HE;
[‡] LC without minimal HE vs. LC with minimal HE

2. K-stroop performance among HCs & LC patients

	HCs	LC without minimal HE	LC with Minimal HE	*p-value	[†] p-value	[‡] p-value
Color (sec)	28.0±8.3	36.5±14.8	50.6±35.5	<0.001	<0.001	0.011
Word (sec)	25.1±5.6	27.8±6.5	35.2±11.6	<0.001	<0.001	<0.001
Inhibition (sec)	29.5±8.6	36.6±14.9	48.3±19.2	<0.001	<0.001	<0.001
Switching (sec)	37.5±12.4	50.4±26.4	63.8±45.9	<0.001	0.001	0.066
C+I (sec)	57.5±15.7	73.1±26.8	98.8±44.9	<0.001	<0.001	<0.001
C+Sw (sec)	65.5±18.5	87.0±37.9	114.7±62.5	<0.001	<0.001	0.006
W+I (sec)	54.6±13.2	64.3±18.2	83.4±27.8	<0.001	<0.001	<0.001
W+Sw (sec)	62.6±16.2	78.2±29.2	99.5±50.5	<0.001	<0.001	0.009

* HCs vs. LC without minimal HE; [†] HCs vs. LC with minimal HE;
[‡] LC without minimal HE vs. LC with minimal HE

3. ROC results for minimal HE in LC patients



	AUC	P-value	95% C.I
C+I (sec)	0.73	<0.001	0.64-0.82
C+Sw (sec)	0.69	<0.001	0.60-0.78
W+I (sec)	0.75	<0.001	0.67-0.84
W+Sw (sec)	0.67	<0.001	0.58-0.77

Cut-off point for W+I 70.5 sec
sensitivity 67.4%, specificity 77.4%

	Univariate		Multivariate	
	Odds ratio	p-value	Odds ratio	p-value
Female	2.02	0.038	2.83	0.013
Age (years)	1.05	0.060	0.99	0.620
Education (years)	0.89	0.026	1.011	0.876
W+I (sec)	1.04	<0.001	1.04	0.005
Platelet (X10 ³ /uL)	1.00	0.139		
Prothrombin time (INR)	1.83	0.413		
Albumin (g/dL)	0.50	0.019	0.65	0.200
ALT (IU/L)	1.00	0.772		
Total bilirubin (mg/dL)	1.23	0.227		
Sodium (mmol/L)	0.90	0.123		
Ammonia (mmol/L)	1.00	0.404		
MELD	1.04	0.453		

METHOD II

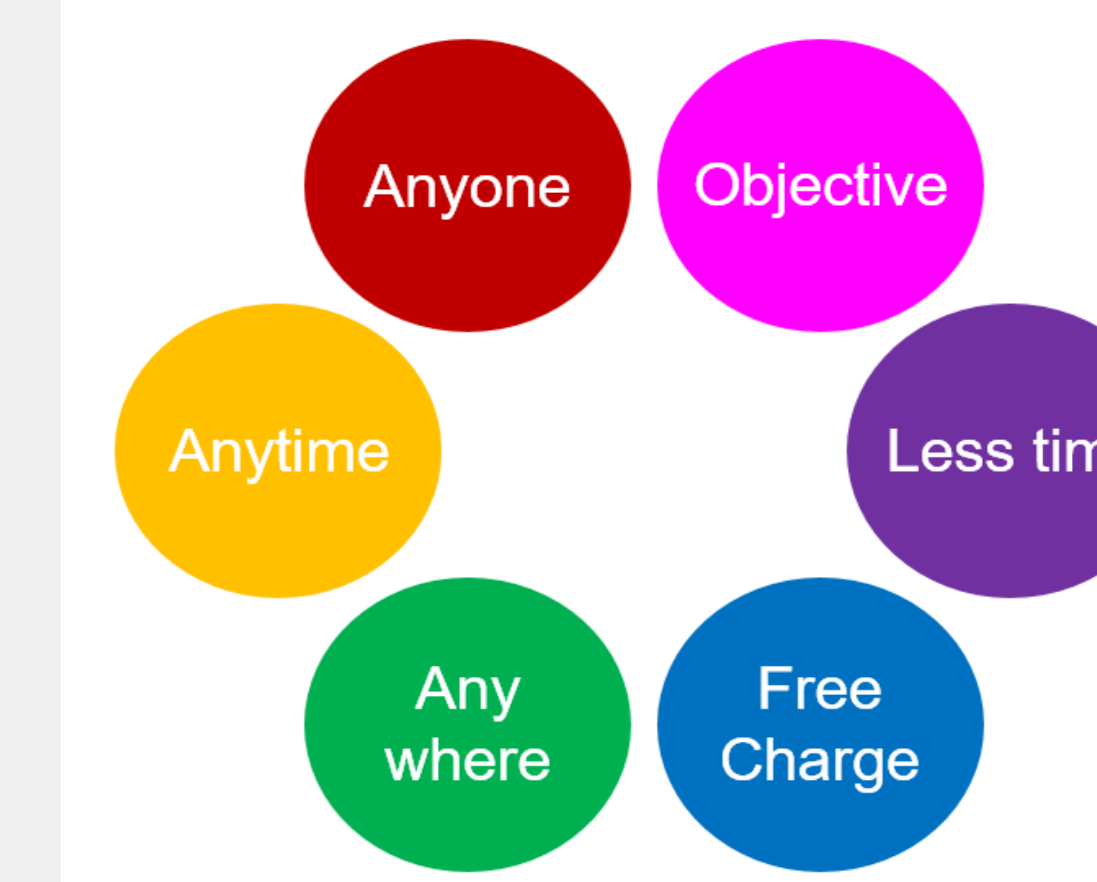
Four tests included in the K-stroop test



Stroop "Off" states: Color Test, Word Test
 Stroop "On" states: Inhibition Test, Inhibition/Switching Test
<http://encephalopathy.or.kr>

CONCLUSIONS

- Mobile-based K-stroop test is a simple and valid method to screen for the minimal HE in real-life practice.
- K-stroop test can serve as one of diagnostic tools of minimal HE in multi-center studies alongside with paper-pencil test.



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