Performance of Prediction Scores for Steatotic Liver Disease in Thai PWH on INSTI-based ART

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Napon Hiranburana[1,2], Tanakorn Apornpong[1], Win Min Han[1,2,3], Stephen J. Kerr[1,3,4], Anchalee Avihingsanon[1,2]

1 HIV-NAT, Thai Red Cross AIDS Research Centre, Bangkok, Thailand, 2 Center of Excellence in Tuberculosis, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand,
3 The Kirby Institute, University of New South Wales, Sydney, Australia, 4.Research Affairs, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand

BACKGROUND

- Steatotic liver disease (SLD) is an increasingly recognized complication in people with HIV (PWH) on integrase strand transfer inhibitor (INSTI)-based ART.
- In resource-limited settings without transient elastography (TE) or ultrasound (US), simple prediction scores using available clinical information could help identify SLD, but their performance in PLWH with INSTI-base ART era remains understudied

Lipid accumulation product (LAP) and Hepatic steatosis index (HSI) effectively predict SLD in Thai PWH on INSTI-based ART and may serve as practical screening tools in resource-limited settings.

METHODS

A retrospective analysis of Thai PWH from the prospective HIV-NAT 006 cohort between 2017-2025

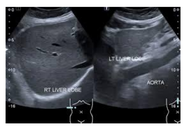
≥ 6 months of INSTI-based ART

- Variables:
  HIV viral load, CD4 count, ART (regimen, duration)
  Hepatitis virus co-infection: HBV/HCV
  DM status, BMI, WC
  alcohol, statin use

Transient elastography



Ultrasound



SLD: Controlled attenuation parameter (CAP) ≥ 263 dB/m on TE or US-confirmed fatty liver.

Prediction scores

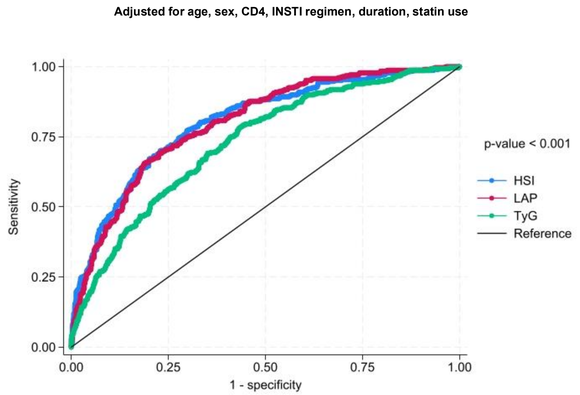
- Hepatic steatosis index (HSI) [cut-off > 36]
- Lipid accumulation product (LAP) [cut-off > 42.7]
- Triglyceride-glucose (TyG) index [cut-off > 4.61]

- **Predictive accuracy**: Area under the receiver operating characteristic curve (AUROC) (Assessed overall and stratified by HBV/HCV co-infection)
- **Model fit and discrimination**: Akaike information criterion (AIC), Bayesian information criterion (BIC)

Note:
1. HSI = 8 x ALT/AST + BMI (+ 2 if type 2 diabetes yes, + 2 if female)
2. LAP = (WC (cm) - 65) x TG (mmol/L)) for men,
and (LAP = (WC (cm) - 58) x TG (mmol/L)) for women
3. TyG index = Ln (fasting triglycerides [mg/dL] × fasting glucose [mg/dL])/2

RESULTS

Figure 1: Receiver operating characteristic (ROC) curve for detection of SLD (CAP>263 dB/m or fatty liver by ultrasound)



Overall
- **LAP**
  : **AUROC 0.794**, 95%CI 0.768–0.820
- **HSI**
  : **AUROC 0.792**, 95%CI 0.765–0.819
- **TyG**
  : **AUROC 0.709**, 95%CI 0.679–0.740
; p<0.001

- In participants with HBV/HCV co-infection HSI and TyG predictive accuracy declined
  - LAP retained the best performance (AUROC 0.799) followed by HSI (AUROC 0.744)
- In those without HBV/HCV co-infection
  - HSI performed best (AUROC 0.809) followed by LAP (AUROC 0.788)

Table 1: Baseline characteristic

Characteristics	Total (n=1389)	SLD (CAP < 263) N=985	SLD (CAP ≥ 263) N=404	p-value
Sex, n (%)				0.018
Female	432 (31.1%)	325 (33.0%)	107 (26.5%)	
Male	957 (68.9%)	660 (67.0%)	297 (73.5%)	
Age (years), median (IQR)	46.3 (34.4-54.4)	45.4 (33.8-53.4)	48.3 (36.1-56.0)	<0.001
BMI (kg/m²), median (IQR)	23.1 (20.8-25.7)	22.1 (20.2-24.1)	26.1 (23.6-28.7)	<0.001
Waist, (cm), median (IQR)	83.0 (77.0-91.0)	81.0 (75.0-87.0)	92.0 (85.0-99.0)	<0.001
Alcohol use, n (%)				0.493
Never	1,003 (83.7%)	704 (83.1%)	299 (84.9%)	
Use	196 (16.3%)	143 (16.9%)	53 (15.1%)	
HBV co-infection, n (%)	222 (17.5%)	152 (17.1%)	70 (18.4%)	0.629
HCV co-infection, n (%)	199 (15.9%)	138 (15.8%)	61 (16.2%)	0.866
HBV or HCV, n (%)	391 (31.6%)	272 (31.4%)	119 (32.0%)	0.830
Diabetes mellitus, n (%)	141 (10.2%)	68 (6.9%)	73 (18.1%)	<0.001
CAP, (dB/m), median (IQR)	223 (189-267)	204 (179-229)	293 (275-320)	<0.001
Stiffness, (kPa), median (IQR)	4.9 (4.1-6.0)	4.6 (3.9-5.7)	5.3 (4.5-6.6)	<0.001
ultrasound-confirmed fatty liver, n (%)	28 (2.0%)	0 (0.0%)	28 (6.9%)	<0.001
Hepatic steatosis index (HSI) median (IQR)	32.5 (28.9-36.6)	31.0 (28.1-34.4)	37.2 (33.4-41.5)	<0.001
HSI category, n (%)				<0.001
HSI ≤36	970 (71.9%)	804 (84.1%)	166 (42.2%)	
HSI >36	379 (28.1%)	152 (15.9%)	227 (57.8%)	
Lipid accumulation product (LAP), median (IQR)	23.5 (13.1-42.0)	18.5 (10.2-30.8)	43.8 (28.0-67.4)	<0.001
LAP category, n (%)				<0.001
LAP ≤42.7	1,016 (75.7%)	825 (86.7%)	191 (49.0%)	
LAP >42.7	326 (24.3%)	127 (13.3%)	199 (51.0%)	
Triglyceride-glucose index, (TyG) median (IQR)	4.6 (4.4-4.8)	4.5 (4.3-4.7)	4.7 (4.5-5.0)	<0.001
TyG category, n (%)				<0.001
TyG< 4.61	757 (54.8%)	623 (63.7%)	134 (33.2%)	
TyG ≥4.61	625 (45.2%)	355 (36.3%)	270 (66.8%)	
CD4-T cell count (cell/mm³), median (IQR)	611 (457-803)	588 (438-764)	683 (499-869)	<0.001
Undetectable viral load (<50 copies/mL), n (%)	1,299 (96.6%)	919 (96.0%)	380 (97.9%)	0.097
INSTI duration, month, median (IQR)	28.5 (12.8-38.0)	25.9 (12.5-36.9)	31.1 (16.9-41.9)	<0.001
INSTI-base regimen, n (%)				0.019
DTG	1,187 (85.5%)	856 (86.9%)	331 (81.9%)	
BIC	65 (4.7%)	46 (4.7%)	19 (4.7%)	
EVG	81 (5.8%)	45 (4.6%)	36 (8.9%)	
RAL	56 (4.0%)	38 (3.9%)	18 (4.5%)	
Statin use, n (%)	273 (19.7%)	166 (16.9%)	107 (26.5%)	<0.001

Table 2: Factors associated with SLD in multiple logistic regression analysis

Multivariable model	Odds ratio (95%CI), p-value for SLD		
	HSI	LAP	TyG
Male vs female	1.75 (1.25-2.47) p=0.001	1.85 (1.32-2.6) P<0.001	1.43 (1.04-1.96) p=0.026
Age in year increasing	1.03 (1.02-1.04) P<0.001	1 (0.99-1.02) p=0.574	1 (0.99-1.01) p=0.718
CD4>500 vs <500	1.34 (0.96-1.87) p=0.081	1.52 (1.09-2.12) p=0.015	1.51 (1.11-2.06) p=0.009
Duration of INSTI, month increasing	1.01 (1-1.02) p=0.002	1.01 (1-1.02) p=0.066	1.01 (1-1.02) p=0.020
INSTI-base regimen			
DTG	Ref		
BIC	1.40 (0.68-2.91) p=0.363	1.11 (0.52-2.36) p=0.795	0.99 (0.5-1.97) p=0.974
EVG	1.52 (0.83-2.79) p=0.18	1.61 (0.88-2.94) p=0.122	1.36 (0.77-2.41) p=0.287
RAL	0.43 (0.18-1.05) p=0.064	0.49 (0.2-1.19) p=0.115	0.41 (0.17-0.97) p=0.043
Model1: for continuous Index	1.22 (1.19-1.26), P<0.001	1.04 (1.03-1.05) P<0.001	13.06 (7.9-21.59), P<0.001
AIC	**1085.482**	**1113.558**	**1241.281**
BIC	**1130.816**	**1158.891**	**1286.879**
ROC compare, ROC p-value <0.001	0.8027	0.7997	0.7283
Model2: for categorical index (yes/no)	7.19 (5.33-9.7) P<0.001	6.22 (4.57-8.46) P<0.001	3.44 (2.59-4.57) P<0.001

Model1: continuous variables of indicator by adjusted for age (year increasing), duration on INSTI, and CD4 (cell/mm³)
Model2: categorical variables of indicator by adjusted for age (>mean), sex (M/F), INSTI-base regimen, duration on INSTI (>mean), and CD4>500 vs <500 cell/mm³

Of 1,389 participants who have TE or U/S result after >6 months of INSTI
- **1,312 participants have completed information of 3 predictive scores: median age 46 years; 69% male, median BMI 23.1 kg/m²**
- **HBV/HCV co-infection 31.6%**
- **SLD prevalence was 29.1% (MASLD 27.1%), Median CAP : 223 dB/m**
- **Median INSTI duration: 28.5 months (85.5% on DTG-based ART)**

CONCLUSIONS

- **In Thai PWH on INSTI-based ART, LAP and HSI demonstrated high accuracy in predicting SLD and may serve as practical screening tools in resource-limited settings where imaging is unavailable.**
- **LAP, requiring only WC and triglycerides level was particularly robust among those with viral hepatitis co-infection.**

Author Contact Information: napon.hir@gmail.com