Development Of Predictive Model For Use In Diagnosis Of Choledocholithiasis

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BACKGROUND

Gallstone disease is a leading cause of presentation to the emergency department. The diagnosis of biliary disease using Point of Care Ultrasound (POCUS) is growing. Surgeon acceptance of POCUS diagnosis in the emergency department is cited as being hampered by inconsistent imaging of the common bile duct (CBD) by POCUS. We set out to determine the relative clinical contribution of ultrasound identified CBD size, patient and biochemical factors in predicting choledocholithiasis.

Development of predictive tool for identification of choledocholithiasis in the absence of common bile duct size can avoid the need for an ultrasound performed by the Radiology department, reduce wait times in the emergency department, and save valuable healthcare resources

RESEARCH DESIGN

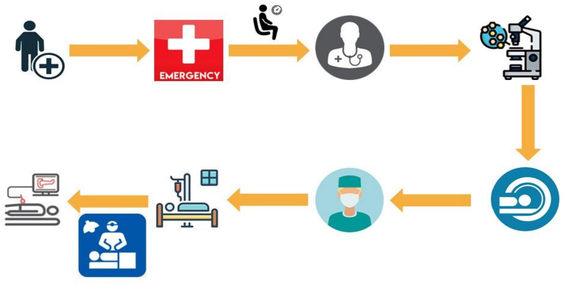
Single center, retrospective cohort study (2014-2019); including all patients >17 years of age that received an inpatient ERCP procedure for suspected biliary obstructive disease. Excluded liver transplant, trauma, post-operative bile leak, known cancer or obstructive disease.

Patient Factors
Age
Sex
BMI

Radiographic Factors
CBD Size
CBD Stone

Biochemical Markers
WBC
Total Bilirubin
Direct Bilirubin
ALT/AST/ALP
GGT
Amylase
Lipase

METHODOLOGY



The typical care journey for the patients in this study involved presentation to the emergency department with abdominal pain, assessed by an emergency department physician, and bloodwork drawn including liver enzymes (first bloodwork included in the analysis). Based on the results of initial bloodwork, they underwent imaging with suspicion of biliary pathology. They were subsequently referred to the on-call General surgery team and admitted for an ERCP procedure with a suspicion of biliary obstructive disease.

STATISTICAL ANALYSIS

1. Cut-off points for continuous variables calculated using Liu index method (Table 1)
2. Predictors in univariate analysis used to build a multivariate model
3. Multivariate model developed using backward stepwise approach including significant variables in univariate analysis and based on clinical judgement
4. Sensitivity analysis, ROC curve for the final regression models
5. Predictive scoring system (nomogram) developed

Independent Variables	Categories
CBD Size	<6 6-10 >10
Total Bilirubin	0 – 32.54 ≥ 32.55
Direct Bilirubin	0 – 22.84 ≥ 22.85
ALT	0 – 127.49 ≥ 127.50
AST	0 – 137.99 ≥ 138
ALP	0 – 218.99 ≥ 219

Table 1: Categorization of continuous, independent variables

RESULTS

Of 665 patients reviewed, 361 were included in the analysis; 65% had an ERCP confirmed choledocholithiasis). In univariate logistic regression, CBD size, total bilirubin, direct bilirubin, AST, ALT, and ALP levels were significantly associated with choledocholithiasis. Using a backward stepwise multivariate model, age, sex, white blood cell count, direct bilirubin, ALP, and ALT were not significantly associated with stone disease. Significant variables were CBD size, total bilirubin, and AST levels, with pseudo-R2=0.32 and ROC of 86%. In the analysis without CBD size, total bilirubin and AST levels were still significant predictors of choledocholithiasis, with pseudo-R2=0.27, and ROC of 83%.

	With CBD Size OR (p-value)	Without CBD Size OR (p-value)
Age (reference: <55yrs)	1.11 (0.81)	1.00 (0.99)
Sex (reference: Female)	0.95 (0.85)	0.76 (0.18)
Total Bilirubin ≥32.55	**17.3 (<0.001)**	**17.5 (<0.001)**
Direct Bilirubin ≥22.85	1.04 (0.96)	0.77 (0.69)
AST ≥138	**2.62 (0.04)**	**2.45 (0.03)**
ALT ≥127	1.14 (0.77)	1.09 (0.83)
ALP ≥219	0.57 (0.18)	0.66 (0.24)
CBD size 6 – 10 >10	1.97 (0.16) **2.86 (0.03)**	--- ---

Table 2: Results of multivariate analysis

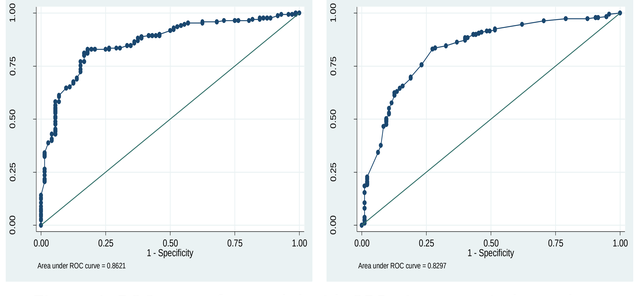


Figure 1: ROC curve for model with CBD size as an independent variable (left); and ROC curve without CBD size in the model (right)

CONCLUSION

In this analysis, we have demonstrated that biochemical parameters are useful in predicting choledocholithiasis even without CBD size. Therefore, users of POCUS in emergency department for biliary disease can feel confident in ruling out choledocholithiasis, using this model, even when CBD is not visualized.

Our predictive model shows utility as a decision-making tool in the emergency department for diagnosis of choledocholithiasis.

Next steps involve a prospective cohort study to validate the model as a clinical decision-making tool for patients presenting to the emergency department with suspected biliary pathology.

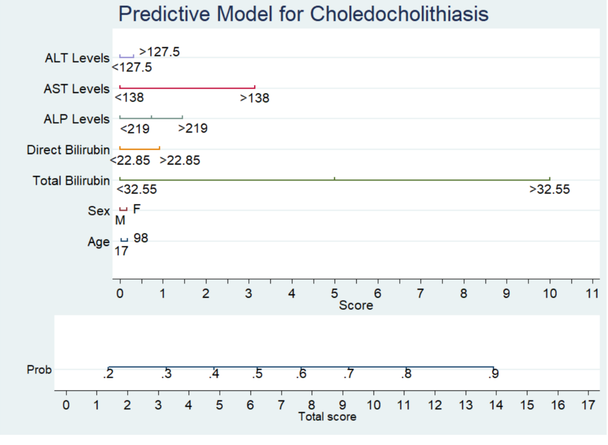


Figure 2: Predictive tool for diagnosing choledocholithiasis without CBD size in the model