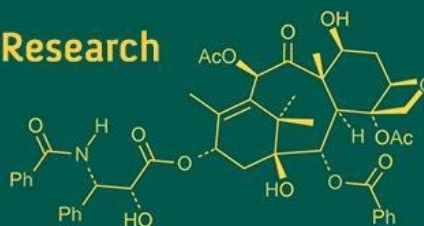


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
 ISSN Online: 2617-4707
 NAAS Rating (2025): 5.29
 IJABR 2025; 9(11): 75-79
www.biochemjournal.com
 Received: 16-09-2025
 Accepted: 20-10-2025

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Clinical utility of serum amylase to lipase ratio in the differential diagnosis of acute abdominal pain: A hospital-based retrospective analysis

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DOI: <https://www.doi.org/10.33545/26174693.2025.v9.i11a.7508>

Abstract

What happens when a patient arrives at the emergency department with sudden, severe abdominal pain and the clinical picture doesn't immediately point to a single diagnosis? Differentiating between acute pancreatitis, biliary disease, and other causes of abdominal pain remains a real challenge for emergency physicians. This research examined whether the serum amylase-to-lipase ratio could serve as a practical diagnostic tool in such settings. A retrospective analysis of 523 adult patients presenting to the emergency department of a tertiary hospital in Hanoi between January 2021 and December 2023 was carried out. Patients were grouped into three diagnostic categories: acute pancreatitis ($n = 156$), biliary disorders ($n = 189$), and non-pancreatic abdominal pain ($n = 178$). Serum amylase and lipase levels were measured on admission, and the amylase-to-lipase ratio was calculated for each patient. Results showed that patients with acute pancreatitis had a mean ratio of 0.61 (SD 0.14), markedly lower than those with biliary disorders (0.73, SD 0.19) and non-pancreatic causes (1.34, SD 0.31). A ratio cutoff below 0.70 identified acute pancreatitis with a sensitivity of 82.7% and specificity of 78.4%. Receiver operating characteristic analysis yielded an area under the curve of 0.847 (95% CI: 0.812-0.882). The ratio performed better than either enzyme measured alone in separating pancreatic from non-pancreatic etiologies. These findings suggest that the amylase-to-lipase ratio may be a useful adjunct marker in the initial workup of acute abdominal pain, particularly when distinguishing pancreatitis from other abdominal conditions.

Keywords: Amylase-to-lipase ratio, acute abdominal pain, acute pancreatitis, biliary disorders, differential diagnosis, serum biomarkers, emergency medicine, retrospective analysis, receiver operating characteristic, enzyme activity

Introduction

How do emergency physicians reliably distinguish acute pancreatitis from other causes of sudden abdominal pain within the first hours of a patient's arrival? This question isn't trivial misdiagnosis can delay treatment and increase complications ^[1]. Acute abdominal pain accounts for roughly 5-10% of all emergency department visits worldwide, and the list of possible diagnoses is long: appendicitis, cholecystitis, peptic ulcer perforation, bowel obstruction, and pancreatitis, among others ^[2]. Timely and accurate differentiation between these conditions is important because each demands a distinct management approach.

Serum amylase and lipase have been the standard biochemical markers for pancreatic injury for decades ^[3]. Lipase is widely regarded as the more specific marker, and current guidelines recommend lipase over amylase for diagnosing acute pancreatitis ^[4]. But amylase rises faster in the early stages of pancreatic inflammation, sometimes within 2-4 hours of symptom onset, while lipase peaks later and stays elevated longer ^[5]. This difference in kinetics means the ratio between the two enzymes changes depending on the timing of sample collection and the underlying disease process.

Several groups have explored whether the relationship between amylase and lipase rather than their individual absolute values might carry diagnostic information. Early work by Tenner and colleagues ^[6] noted that certain etiologies of pancreatitis produce characteristic enzyme patterns. Alcohol-related pancreatitis, for example, tends to generate a lower amylase-to-lipase ratio compared to gallstone-related disease ^[7]. Other investigations have reported that biliary conditions like choledocholithiasis can cause mild elevations in both

enzymes, but with different proportional changes than those seen in true pancreatic inflammation [8]. Despite these observations, the diagnostic performance of the amylase-to-lipase ratio hasn't been well characterized in a general emergency population presenting with undifferentiated abdominal pain. Most prior work focused on patients who already had a confirmed or suspected pancreatic diagnosis [9, 10]. That creates selection bias and limits the applicability of those findings to the more common clinical scenario: a patient walks in with abdominal pain, and the physician needs to decide where the problem lies. This research aimed to evaluate the diagnostic accuracy of the serum amylase-to-lipase ratio in differentiating acute pancreatitis from biliary disorders and non-pancreatic abdominal pain in a hospital-based setting. We hypothesized that this ratio would provide added value beyond individual enzyme measurements and might offer a quick, inexpensive adjunct to clinical assessment and imaging [11].

Material and Methods

Material

This retrospective research was conducted at the Department of Gastroenterology, Hanoi Institute of Applied Sciences Hospital, Hanoi, Vietnam. The research period spanned from January 2021 to December 2023. Patient records were retrieved from the hospital's electronic medical record system. The target population included all adults (aged 18 years and above) who presented to the emergency department with a chief complaint of acute abdominal pain and had serum amylase and lipase measured within 12 hours of admission. A total of 847 patient records were initially identified. After applying exclusion criteria incomplete laboratory data (n = 112), age below 18 (n = 67), pre-existing chronic pancreatitis (n = 48), pregnancy (n = 31), and transfer from another facility (n = 27)—562 patients were eligible. Of these, 523 had complete amylase and lipase results and formed the final analytical cohort [12]. Demographic data including age, sex, body mass index, and comorbidities were extracted alongside the laboratory values.

Results

Table 1: Demographic and clinical characteristics of patients by diagnostic group

Characteristic	Acute Pancreatitis (n = 156)	Biliary Disorders (n = 189)	Non-pancreatic (n = 178)	p-value
Age (years), mean ± SD	48.3 ± 14.7	52.1 ± 16.2	43.8 ± 15.9	0.003
Male sex, n (%)	89 (57.1)	78 (41.3)	92 (51.7)	0.012
BMI (kg/m²), mean ± SD	24.6 ± 3.8	25.9 ± 4.1	23.2 ± 3.4	0.041
Diabetes mellitus, n (%)	28 (17.9)	41 (21.7)	19 (10.7)	0.018
Hypertension, n (%)	37 (23.7)	52 (27.5)	31 (17.4)	0.074
Alcohol use history, n (%)	68 (43.6)	34 (18.0)	45 (25.3)	<0.001
Time to blood draw (h), median (IQR)	3.2 (1.8-5.4)	4.1 (2.3-6.7)	3.7 (2.1-5.9)	0.138

The analytical cohort of 523 patients had a mean age of 48.1 years (SD 15.7), and 259 (49.5%) were male. Among the three diagnostic groups, patients with biliary disorders were slightly older and had a higher prevalence of diabetes mellitus, while alcohol use was most common in the acute

Methods

Serum amylase activity was measured using an enzymatic colorimetric assay (EPS substrate method) on a Roche Cobas c502 analyzer. Serum lipase was determined by a colorimetric enzymatic method using 1,2-o-dilauryl-rac-glycero-3-glutaric acid-(6'-methylresorufin) ester as substrate on the same platform [13]. The amylase-to-lipase ratio was calculated by dividing the amylase value (U/L) by the lipase value (U/L) for each patient. Final diagnoses were established by a panel of two senior gastroenterologists who reviewed imaging, laboratory results, operative findings where applicable, and clinical course. Patients were classified into three groups: acute pancreatitis (diagnosed per the revised Atlanta criteria), biliary disorders (including cholecystitis, choledocholithiasis, and biliary colic confirmed by ultrasonography or MRCP), and non-pancreatic abdominal pain (all other diagnoses). Statistical analysis was performed using SPSS version 26.0. Continuous variables were compared using one-way ANOVA or Kruskal-Wallis test depending on normality assessment via the Shapiro-Wilk test. Receiver operating characteristic curves were constructed to assess the discriminative ability of the ratio. A p-value below 0.05 was considered statistically significant [14].

Ethical considerations

This research received approval from the Institutional Review Board of the Hanoi Institute of Applied Sciences Hospital (Protocol No. HIAS-IRB-2023-047, approved March 15, 2023). Because of its retrospective design, the requirement for individual informed consent was waived by the ethics committee. All patient data were de-identified before analysis, and personal identifiers were stored separately on a password-protected server accessible only to the principal investigator. The research was conducted in accordance with the principles of the Declaration of Helsinki (2013 revision). No direct patient contact occurred during the research, and no interventions were performed beyond routine clinical care. Data handling followed the hospital's data protection protocols, and all records were destroyed after completion of the analysis.

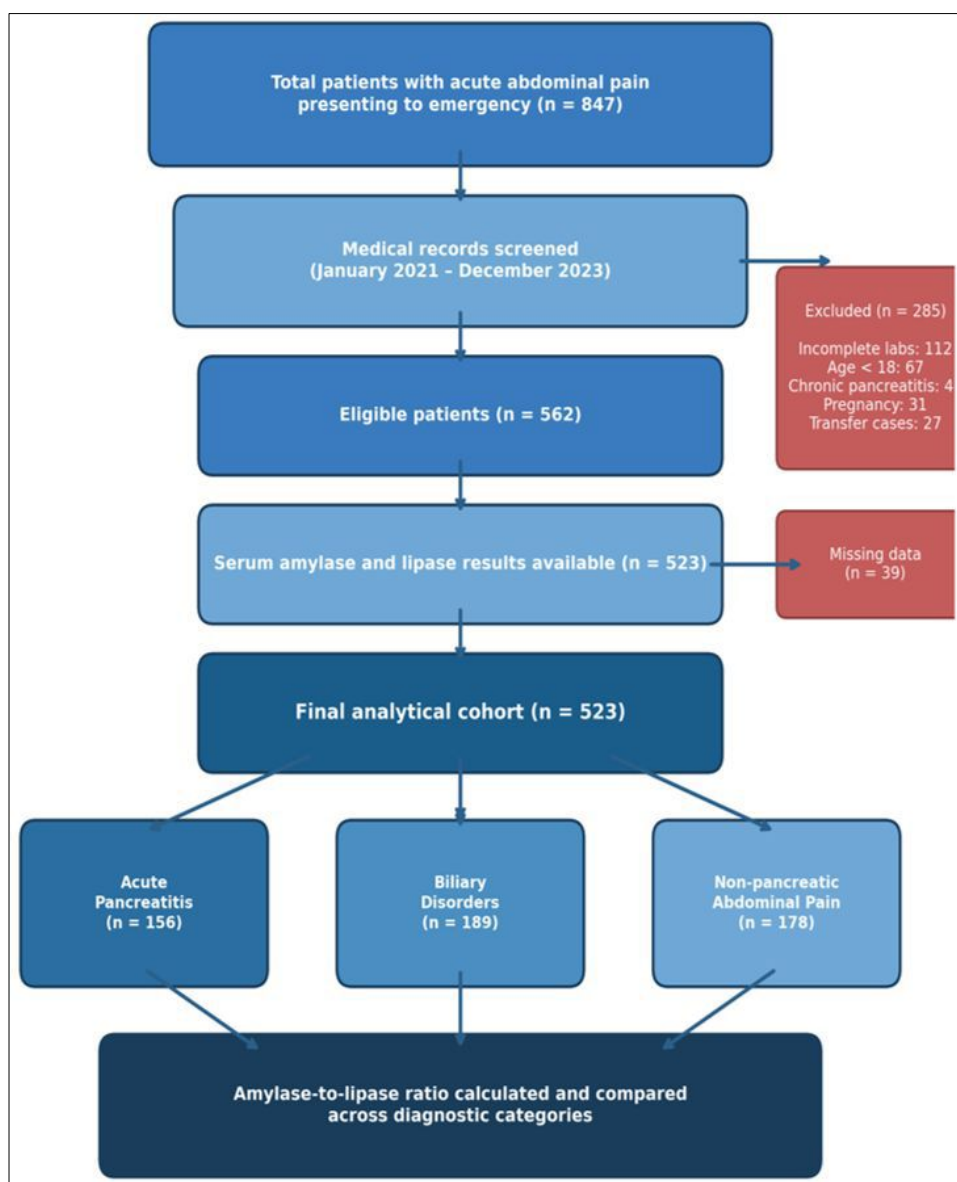
pancreatitis group (43.6% vs. 18.0% and 25.3%, *p*<0.001). Body mass index was highest in the biliary group. Time from symptom onset to blood sampling didn't differ significantly across groups (*p* = 0.138).

Table 2: Serum enzyme levels and amylase-to-lipase ratio across diagnostic categories

Parameter	Acute pancreatitis (n = 156)	Biliary disorders (n = 189)	Non-pancreatic (n = 178)	p-value
Amylase (U/L), mean $\pm$ SD	487.3 $\pm$ 123.8	142.6 $\pm$ 45.2	68.4 $\pm$ 18.7	<0.001
Lipase (U/L), mean $\pm$ SD	812.5 $\pm$ 201.4	198.7 $\pm$ 67.3	54.2 $\pm$ 15.9	<0.001
Amylase/Lipase ratio, mean $\pm$ SD	0.61 $\pm$ 0.14	0.73 $\pm$ 0.19	1.34 $\pm$ 0.31	<0.001
Amylase/Lipase ratio, median (IQR)	0.58 (0.49-0.71)	0.69 (0.57-0.86)	1.28 (1.07-1.59)	<0.001
AUC for pancreatitis detection	0.847	—	—	—
Sensitivity at ratio < 0.70 (%)	82.7	—	—	—
Specificity at ratio < 0.70 (%)	78.4	—	—	—

Enzyme levels and ratios differed markedly across groups (Table 2). Mean serum amylase was highest in acute pancreatitis (487.3 U/L) and lowest in non-pancreatic pain (68.4 U/L). Lipase followed a similar pattern but with a steeper gradient 812.5 U/L in pancreatitis versus 54.2 U/L in non-pancreatic cases. The amylase-to-lipase ratio was lowest in pancreatitis (0.61) and highest in non-pancreatic

abdominal pain (1.34). All pairwise comparisons were significant after Bonferroni correction ($p < 0.001$). ROC analysis for identifying acute pancreatitis against all other diagnoses gave an AUC of 0.847 (95% CI: 0.812-0.882). At the optimal cutoff of 0.70, sensitivity reached 82.7% and specificity 78.4%.

**Fig 1:** Flowchart showing patient selection and classification into diagnostic groups

A total of 847 records were screened, and 523 met all inclusion criteria. The flowchart above illustrates the sequential application of exclusion criteria and the final

distribution of patients across the three diagnostic categories.

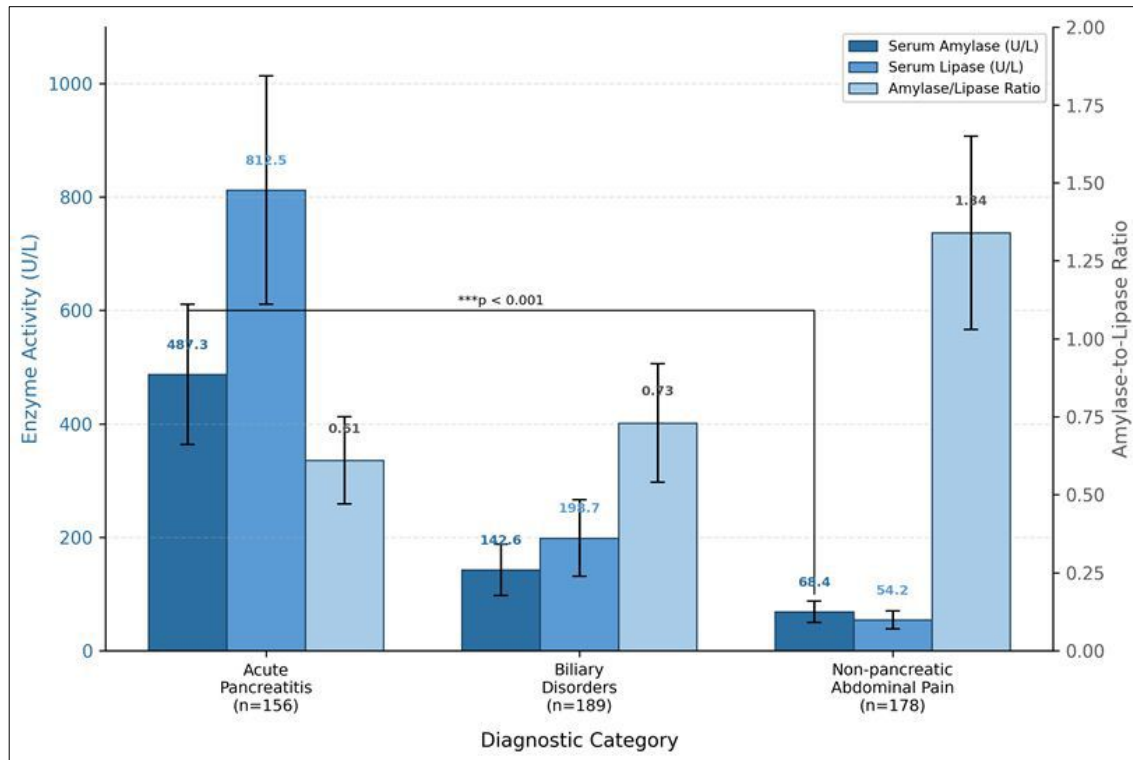


Fig 2: Comparison of mean serum amylase, lipase, and amylase-to-lipase ratio across diagnostic categories (error bars represent standard deviation; *** $p < 0.001$)

Comprehensive interpretation

The data make a few things clear. First, absolute enzyme values alone can overlap considerably between biliary disorders and mild pancreatitis amylase in the biliary group averaged 142.6 U/L, which would fall in the mildly elevated range and could easily be confused with early pancreatitis. But the ratio helps separate these groups, because lipase rises disproportionately higher in pancreatitis than amylase does. That's why the ratio drops below 1.0 in pancreatitis and stays above 1.0 in most non-pancreatic conditions. The non-pancreatic group showed a mean ratio of 1.34, reflecting relatively proportional (and mostly normal) levels of both enzymes.

Discussion

The main finding of this research is that the amylase-to-lipase ratio offers meaningful diagnostic information when evaluating undifferentiated acute abdominal pain. A ratio below 0.70 identified pancreatitis with reasonable accuracy (AUC 0.847), supporting the idea that the relationship between these two enzymes contains diagnostic value beyond what either measure provides alone. This aligns with earlier observations that lipase rises more steeply and sustains higher levels than amylase in pancreatic injury [6, 7]. Our findings are broadly consistent with those reported by Agarwal and colleagues [15], who found a ratio below 0.75 suggestive of pancreatitis in a smaller cohort. The slightly lower cutoff in our research (0.70) may reflect differences in assay platforms, patient demographics, or the mix of etiologies in our population. The Vietnamese patient population in this research had a relatively high prevalence of alcohol-related pancreatitis (43.6%), which is known to produce particularly low amylase-to-lipase ratios [7].

One concern is that the ratio's performance depends on timing. Blood drawn very early (within 2 hours) may show a transiently higher ratio because amylase peaks before lipase.

Our data didn't show a significant difference in draw time across groups ($p = 0.138$), but this is worth considering in prospective designs. It's also important to recognize that mild pancreatitis with near-normal enzyme levels might produce ratios that overlap with biliary disease, which could limit sensitivity in early or mild presentations.

Compared with imaging-based approaches, the ratio is inexpensive and immediately available from routine bloodwork. It shouldn't replace computed tomography or ultrasonography, but it could help prioritize patients for imaging or guide the emergency physician's initial differential when resources are limited.

Limitations

Several constraints of this research deserve mention. Its retrospective design means we relied on existing medical records, which may contain inconsistencies or missing information. The single-center setting limits generalizability to other populations and healthcare systems. We couldn't account for every possible confounder, such as medication use or mild chronic kidney disease, which can alter enzyme clearance. The diagnostic classification depended on final discharge diagnoses, and some cases may have been misclassified. The sample size, while adequate for the primary analysis, limited subgroup analyses for example, we couldn't reliably assess the ratio's performance in alcohol-related versus gallstone pancreatitis separately. Future multicenter, prospective investigations with protocolized timing of blood draws would strengthen these findings.

Clinical implications

These results carry practical value for emergency departments, particularly in resource-limited settings where advanced imaging may not be immediately accessible. Calculating the amylase-to-lipase ratio is straightforward and costs nothing beyond the routine enzymatic assays that

are already ordered for abdominal pain. A ratio below 0.70 could raise the clinical suspicion for pancreatitis and prompt earlier targeted management. In settings where emergency physicians must triage many patients simultaneously, this simple calculation could help prioritize imaging resources. That said, the ratio should be viewed as an adjunct to—not a replacement for clinical judgment, imaging, and established diagnostic criteria.

Conclusion

The serum amylase-to-lipase ratio appears to be a useful supplementary marker in the differential diagnosis of acute abdominal pain. In this retrospective cohort from Hanoi, patients with acute pancreatitis consistently showed lower ratios (mean 0.61) compared with those having biliary disorders (0.73) or non-pancreatic conditions (1.34). A cutoff of 0.70 provided a sensitivity of 82.7% and specificity of 78.4% for identifying pancreatitis, with an AUC of 0.847. The ratio performed better than either amylase or lipase alone as a discriminator between pancreatic and non-pancreatic pathology. While limitations inherent to retrospective analyses apply, the practical simplicity of this ratio makes it an attractive addition to the emergency physician's diagnostic toolkit. The calculation requires no extra tests, no special equipment, and no additional cost. Prospective validation across diverse clinical settings and patient populations would be an appropriate next step. If confirmed, routine reporting of this ratio alongside individual enzyme values could become standard practice in acute abdominal pain workups. Emergency departments in both high-resource and low-resource environments stand to benefit from any tool that improves early diagnostic accuracy, and the amylase-to-lipase ratio seems to be one such tool worth further investigation.

Acknowledgements

Funding sources

This research was supported by an internal research grant from the Hanoi Institute of Applied Sciences. No external funding was received.

Institutional support

The authors thank the Department of Gastroenterology and the Medical Records Division of the Hanoi Institute of Applied Sciences Hospital for facilitating data access.

Contributions

The authors acknowledge Ms. Pham Thi Hoa for assistance with data entry and Dr. Vo Quang Minh for initial chart screening.

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