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The clinical characteristic of alcohol-hyperlipidemia etiologically complex type of acute pancreatitis

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Abstract. – OBJECTIVE: The aim of our study was to elucidate the clinical characteristics of alcoholic-hyperlipidemic etiologically complex acute pancreatitis.

PATIENTS AND METHODS: We reviewed complete data from 233 patients with acute pancreatitis treated in our hospital during the period January 2017-January 2022. They were divided into three groups according to etiology: alcoholic acute pancreatitis (AAP), hyperlipidemic acute pancreatitis (HLAP), and alcoholic-hyperlipidemic acute pancreatitis (AHAP). General clinical data, co-morbidities, laboratory results, imaging data, and disease severity were analyzed and compared between groups.

RESULTS: The proportion of male individuals in the AHAP group was significantly higher than that in the HLAP group ($p<0.001$). Age of onset was lower and the number of cases with antibiotic use was higher in the AHAP group than in the AAP group ($p<0.05$). Additionally, the average alcohol intake each time and weekly alcohol intake were also higher in the AHAP group than in the AAP group ($p<0.05$). Comparison of disease severity (moderate and severe acute pancreatitis, severe acute pancreatitis, and modified computed tomography severity index score) revealed the disease condition to be more severe in the AHAP group than in the AAP and HLAP groups ($p<0.05$). Accordingly, patients in the AHAP group had longer hospital stays than those in the other two groups ($p<0.05$). There were no significant differences in alcohol consumption, severity, or length of hospital stay in the AHAP group ($p>0.05$).

CONCLUSIONS: The clinical characteristics of patients in the AHAP, AAP and HLAP groups were different, and the patients in the AHAP group were more likely to have a moderate to severe disease course, with longer hospital stay. As a new AP classification concept, AHAP would offer high significance for diagnosis, treatment, and prognosis.

Key Words:
Acute pancreatitis, Alcoholic acute pancreatitis, Hyperlipidemia acute pancreatitis, Alcohol-hyperlipidemia acute pancreatitis.

Introduction

Acute pancreatitis (AP) is a common inflammatory gastrointestinal disease with an increasing annual incidence potentially resulting from the increasing prevalence of obesity[1]. In this condition, the pancreas undergoes autodigestion following the activation of pancreatic enzymes by various etiologies. AP is mainly characterized by local inflammation, and severely ill patients may develop systemic inflammatory response syndrome, often accompanied by organ dysfunctions.

The pathogenic factors behind acute pancreatitis are complex and numerous in clinical settings, and certain correlations and mutual influences exist among the various etiologies. The currently accepted classifications of AP based on etiology primarily include biliary type, hyperlipidemic type, and alcoholic type, with rarer instances of hypercalcemia, pancreatic tumors, viruses, drugs, heredity, and autoimmunity[2]. The prevalence of hyperlipidemic pancreatitis has recently

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increased, with a severer trend toward younger populations. A potential pathogenesis introduced by previous studies[3,4] is the direct toxic effect of free fatty acids decomposed by triglycerides (TGs) on the pancreas and resulting pancreatic microcirculation disorder.

The academic concept of 'a single etiology leading to acute pancreatitis' is deeply rooted. However, in clinical practice, pancreatitis caused by combined (two or more) etiologies, such as alcoholic pancreatitis complicated by hyperlipidemic pancreatitis, is not uncommon. As no clinically practicable diagnostic standards currently exist for this type of pancreatitis, this study aimed at providing a basis for investigating a new classification method for inter-related etiologies of acute pancreatitis. To this end, we investigated whether the concept of alcoholic-hyperlipidemic etiologically complex type of pancreatitis is feasible by analyzing its epidemiological and clinical characteristics, with the goal of setting a basis for future research.

Patients and Methods

Research Subjects

We retrospectively reviewed the records of 233 AP patients for which complete data were available and who had been hospitalized in Ordos Central Hospital between January 2017 and January 2022. They were divided into three groups, according to etiology, with 53 cases of alcoholic acute pancreatitis (AAP), 90 of hyperlipidemic acute pancreatitis (HLAP) and 90 of alcoholic-hyperlipidemic acute pancreatitis (AHAP). This study was approved by the Ethics Committee of Ordos Central Hospital and was conducted under the guidelines of the Declaration of Helsinki.

Inclusion Criteria

Alcoholic Acute Pancreatitis (AAP)

For the inclusion in the AAP category, patients were first required to meet two of the following three diagnostic criteria from the guidelines for the diagnosis and treatment of AP: (1) persistent upper abdominal pain, (2) serum amylase and/or lipase levels ≥ 3 times the upper limit of the reference range, and (3) contrast-enhanced computed tomography (CT) or magnetic resonance imaging showing imaging changes typical of AP[3].

Second, patients' AP was required to be solely attributable to drinking, and a drinking history of approximately 5 years was required. Patients with other pancreatitis etiologies, such as biliary tract disease, hyperlipidemia, trauma, or tumors, were excluded from the category.

Hyperlipidemic Acute Pancreatitis (HLAP)

For inclusion in the HLAP category, patients were required to meet the diagnostic criteria for AP [as shown in Alcoholic acute pancreatitis (AAP)]. Second, patients must have had concurrent hypertriglyceridemia [serum TG levels ≥ 1,000 mg/dL (11.3 mmol/L)], or serum TG levels in the range of 500-1,000 mg/dL (5.65-11.3 mmol/L) with chylous serum. Patients with other etiologies of AP were excluded from this category.

Alcoholic-Hyperlipidemic Acute Pancreatitis (AHAP)

For inclusion in the AHAP category, patients must have met the diagnostic criteria for AP [as shown in Alcoholic acute pancreatitis (AAP)] and presented with features of both hyperlipidemic and alcoholic pancreatitis. Patients with other etiologies of AP were excluded from this category.

Clinical Data Collection

General information

Patient data, including sex, age, pancreatitis etiology, diabetes, hypertension, antibiotic use, and expenses, were collected. Additionally, the following laboratory data were collected upon admission: white blood cell, lymphocyte, monocyte, red blood cell, and platelet counts, eosinophil and basophil ratios, and hemoglobin, alanine aminotransferase, aspartate aminotransferase, albumin, creatinine, sodium ions, calcium ions, blood amylase, blood lipase, TG, total cholesterol, high-density lipoprotein, low-density lipoprotein, prothrombin, and fibrinogen levels.

Severity assessment

Patients were subclassified into moderate and severe acute pancreatitis (MSAP) and severe acute pancreatitis (SAP)[5]. The modified CT severity index score (MCTSI) was also used for assessment.

Clinical outcomes

Length of hospital stay, and performance of percutaneous catheter drainage (PCD) procedure were measured as clinical outcomes.

Alcohol intake

The average alcoholic consumption per event (ml), alcohol concentration (%), and average weekly drinking frequency (times) were recorded; the average alcohol intake per event (g) and average weekly alcohol intake (g) were calculated.

Amount of alcohol intake was calculated through the following formulas: average alcohol intake each time (g) = average alcoholic drink consumption each time (ml) × alcohol concentration (%) × 0.8 (alcohol density). Weekly alcohol intake (g) = average alcoholic drink consumption each time (ml) × alcohol concentration (%) × 0.8 (alcohol density) × average weekly drinking frequency (times/week).

Statistical Analysis

SPSS 25.0 software (IBM Corp., Armonk, NY, USA) was used for statistical analyses, and measurement data with normal distribution are shown as means±standard deviations. Comparisons between two groups were performed by an independent samples *t*-test, and comparison of measurement data that did not conform to a normal distribution was performed by Mann-Whitney U test. A Chi-square test or Fisher's exact test was used to compare the enumeration data between two groups. Differences were considered statistically significant when $p<0.05$.

Results

General Data Comparisons Between the AHAP, AAP, and HLAP Groups

Nearly all patients in the AHAP and AAP groups were male individuals, and the proportion of male individuals in the HLAP group was 66.7%. The proportion of male individuals in the AHAP group was significantly higher than that in the HLAP group ($p<0.001$). There was no significant difference in age between the AHAP and AAP groups ($p>0.05$). Compared with those in the HLAP group, the patients in the AHAP group were younger and had used more antibiotics, and the difference was significant ($p<0.05$). There was no significant difference in hospitalization cost, concurrent hypertension, or diabetes mellitus between the AHAP and AAP groups or AHAP and HLAP groups ($p>0.05$) (Table I).

Comparison of Laboratory Data Among the AHAP, AAP, and HLAP Groups

There were no significant differences in the white blood cell, lymphocyte, monocyte, red blood cell, and platelet counts, basophil and eosinophil ratios, or hemoglobin, alanine aminotransferase, aspartate aminotransferase, albumin, creatinine, sodium ion, calcium ion, blood amylase, blood lipase, high-density lipoprotein, low-density lipoprotein, prothrombin, and fibrinogen levels ($p>0.05$) between the AHAP and AAP groups or AHAP and HLAP groups. However, there were significant differences in TG and total cholesterol levels between the AHAP and AAP groups ($p<0.05$) (Table II).

Comparisons of Alcohol Intake, Severity, PCD Treatment, and Length of Hospital Stay Between Groups

Regarding average alcohol intake, the intake per event and weekly alcohol intake in the AHAP group were higher than those in the AAP group, and the differences were significant ($p<0.05$). There were also significant differences in severity (MSAP and SAP, as well as the MCTSI) and length of hospital stay

Table I. Comparison of general data of AHAP, AAP and HLAP groups.

	AHAP	AAP	HLAP	*p*1	*p*2
Number	90	53	90	–	–
Male (%)	88 (97.8)	52 (98.1)	60 (66.7)	1.000	0.000
Age (years)	39.1 ± 6.6	40.0 ± 10.0	41.9 ± 8.4	0.558	0.014
Cost (RMB)	21,040	15,755	17,891	0.245	0.499
History of hypertension	17	8	18	0.564	0.851
History of diabetes mellitus	22	8	29	0.185	0.247
Antibiotic (case)	14	5	5	0.298	0.029

AHAP: alcohol-hyperlipidemia acute pancreatitis; AAP: alcoholic acute pancreatitis; HLAP: hyperlipidemia acute pancreatitis; *p*1: Comparison between AHAP and AAP groups; *p*2: Comparison between AHAP and HLAP groups.

Table II. Comparison of laboratory data between AHAP, AAP and HLAP.

	AHAP	AAP	HLAP	*p*1	*p*2
WBC (10^9/l)	11.6 ± 4.2	12.8 ± 2.2	13.6 ± 17.0	0.111	0.286
LYMPH (10^9/l)	1.3 ± 0.6	1.4 ± 0.6	1.4 ± 0.5	0.603	0.885
MONO (10^9/l)	0.7 ± 0.3	0.8 ± 0.4	0.7 ± 0.5	0.060	0.900
BASO (10^9/l)	0.1 ± 0.1	0.1 ± 0.1	0.1 ± 0.1	0.119	0.252
EO (10^9/l)	0.1 ± 0.2	0.04 ± 0.04	0.03 ± 0.04	0.322	0.090
RBC (10^{12}/l)	5.0 ± 0.6	5.0 ± 0.5	5.0 ± 0.66	0.626	0.785
Hgb (10^{12}/l)	159.8 ± 19.2	157.7 ± 15.8	155.8 ± 22.7	0.529	0.212
PLT (10^9/l)	202.4 ± 57.1	226.5 ± 106.4	228.0 ± 65.1	0.120	0.018
AST (u/l)	38.8 ± 37.8	43.0 ± 32.3	30.3 ± 15.5	0.510	0.064
ALT(u/l)	41.4 ± 63.8	35.6 ± 23.0	27.1 ± 14.5	0.555	0.052
ALB (g/l)	44.2 ± 5.6	44.2 ± 5.5	43.8 ± 5.4	0.945	0.591
Cr (umol/l)	72.4 ± 37.7	70.4 ± 17.4	66.0 ± 39.6	0.736	0.276
Na^+ (mmol/l)	136.1 ± 4.4	137.3 ± 4.5	134.3 ± 13.7	0.138	0.239
Ca^{2+} (mmol/l)	2.2 ± 0.3	2.3 ± 0.2	2.4 ± 2.3	0.107	0.377
LPS (u/l)	250.9 ± 243.9	249.1 ± 255.3	271.0 ± 252.1	0.969	0.622
AMS(u/l)	236.8 ± 238.1	227.9 ± 278.9	276.7 ± 308.9	0.848	0.358
TC (mmol/l)	8.4 ± 3.6	5.6 ± 2.5	9.8 ± 3.8	0.000	0.304
TG (mmol/l)	21.7 ± 12.3	4.3 ± 2.3	21.1 ± 13.3	0.013	0.922
HDL (mmol/l)	1.0 ± 1.3	1.0 ± .0.4	0.7 ± 0.3	0.774	0.090
LDL (mmol/l)	4.4 ± 2.5	2.3 ± 1.3	1.6 ± 1.0	0.605	0.317
PT (s)	12.2 ± 1.4	11.7 ± 1.0	12.3 ± 2.4	0.055	0.737
FIB (g/l)	4.3 ± 2.2	4.4 ± 2.4	4.0 ± 1.7	0.859	0.404

WBC: white blood cells; LYMPH: lymphocytes; MONO: monocytes; BASO: basophils; EO: eosinophils; RBC: red blood cells; Hgb: hemoglobin; PLT: platelet; ALT: Alanine aminotransferase; AST: Aspartate aminotransferase; ALB: Albumin; Cr: Creatinine; Na^+: Sodium ion; Ca^{2+}: calcium ion; LPS: blood lipase; AMS: blood amylase; TC: total cholesterol; TG: triglyceride; HDL: high density lipoprotein; LDL: low density lipoprotein; PT: prothrombin; FIB: Fibrinogen; AHAP: alcohol-hyperlipidemia acute pancreatitis, AAP: alcoholic acute pancreatitis, HLAP: hyperlipidemia acute pancreatitis, *p*1: Comparison between AHAP and AAP groups; *p*2: Comparison between AHAP and HLAP groups.

between the AHAP and AAP groups, as well as the AHAP and HLAP groups ($p<0.05$). However, there was no significant difference in PCD treatment between any of the groups ($p>0.05$) (Table III).

Receiver Operating Characteristic Curve Area and Cut-Off Value in the AHAP Group

The receiver operating characteristic curves of the alcohol intake per event and weekly intake were plotted, and the areas under the curve were 0.644 and 0.602, respectively. When the value of the average alcohol intake each time was 104, the Youden Index was the largest with a sensitivity of 69.9% and specificity of 56.1%. When the average weekly alcohol intake value was 232, the Youden Index was the largest with a sensitivity of 77.8% and a specificity of 59.6%.

Comparison of the average alcohol intake per event/weekly with severity and length of hospital stay in the AHAP group.

Table III. Comparison of results of alcohol intake, severity, PCD treatment, and days of hospitalization between AHAP and AAP groups, and AHAP and HLAP groups.

	AHAP	AAP	HLAP	*p*1	*p*2
Number	90	53	90	–	–
Average of each alcohol intake (grams)	152.6 ± 75.7	125.7 ± 51.3		0.035	
Average of weekly alcohol intake (grams)	500.8 ± 427.6	357.1 ± 237.6		0.044	
MSAP and SAP	18	3	7	0.021	0.018
MCTSI	4 (4.5)	4 (2.4)	4 (2.4)	0.007	0.010
PCD	6	2	5	0.726	0.756
Hospitalization(days)	15.7 ± 10.2	12.3 ± 7.5	11.9 ± 6.6	0.040	0.030

The cut-off values of 104 and 232 for the average alcohol intake per event and weekly intake, respectively, were chosen to subclassify patients in the AHAP group into the high alcohol intake and low alcohol intake groups for comparison. The results showed no significant differences in severity or length of hospital stay between the high and low alcohol intake groups (p>0.05) (Table IV).

Discussion

After analysis of the epidemiological and clinical characteristics of AHAP and comparison with those of AAP and HLAP, this study found that patients in the AHAP group were more likely to have to a moderate to severe disease course with longer hospital stay.

The diagnosis of AP comprises two parts, including the diagnosis of the disease itself and determination of its severity. Further, early identification of the etiology behind AP indicates whether removal of that etiology is necessary, to predict the degree of disease progression early, to implement effective preventive measures in time, to avoid the aggravation, and to conserve limited medical resources. Early intervention for AP includes fluid therapy, analgesia and nutritional therapy, treatment for some etiologies and early complications.

In this study, we made use of a novel term for AP caused by both alcohol and TGs called AHAP to make comparisons with this classification. We believe that our results provide a basis for further investigation into whether AHAP should be established as a new etiological classification.

There is some lack of clarity surrounding the existing classifications. The threshold of TG-triggered AP is still unclear, and there are no uniform diagnostic criteria for HLAP. However, it is generally accepted that diagnosis is firstly required to meet the AP diagnostic criteria of the 2012 revised Atlanta classification of acute pancreatitis by international consensus. Further, the criteria for alcoholic etiology are even more difficult to quantify, with no universally accepted criteria agreed upon in the academic community. The duration and frequency of drinking and average amount of alcohol consumed per day require further investigation, as doing so is subject to considerable error and uncertainty[6]. Additionally, numerous differences also exist between various studies[7,8] regarding reported alcohol intake. For example, Lee and Papachristou[7] reported that drinking 35 standard cups per week for 5 years can be adopted as the diagnostic criteria for alcoholic pancreatitis (one standard cup is equivalent to 10 g of alcohol). Conversely, Munoz et al[8] pointed out that the occurrence of alcohol-caused AP requires frequent intake of alcohol or heavy drinking (more than 80 mL of alcohol within 24 h).

Our study found that in some patients, AP was associated with alcoholic factors but also met the diagnostic criteria for HLAP, and such cases of AP were considered as those of AHAP. These AHAP patients had unique clinical characteristics: first, compared with those in the HLAP group, the vast majority of patients in the AHAP were male individuals; second, compared with those in the AAP group, their age of onset was younger; third, there were more patients in the AHAP group who were administered antibiotics than those in the HLAP group; fourth, patients in the AHAP group had higher average alcohol intake than those in the AAP group; fifth, the disease was more severe (MSAP and SAP, as well as the MCSI) in the AHAP group than in the AAP and HLAP groups; sixth, the length of hospital stay was longer in the AHAP group than in the AAP and HLAP groups. The higher proportion of male individuals in the AHAP group was consistent with that reported in previous studies[4] that showed that alcohol consumption was more

Table IV. Comparison of severity and length of hospital stay between high alcohol intake and low alcohol intake groups subdivided from the AHAP group.

	Average alcohol intake per event			Average alcohol intake per week		
	≥ 104 g group	≥ 104 g group	p	≥ 232 g group	≥ 232 g group	p
Number	65	25		68	22	
MSAP and SAP	13	5	1.000	12	6	0.500
MCTSI	4 (4.5)	4 (4.4)	0.839	4 (4.5)	4 (4.5)	0.737
Hospitalization (days)	15.5 ± 10.5	15.0 ± 9.9	0.821	15.4 ± 10.3	15.1 ± 10.1	0.638

common in young men, who had greater amounts and longer durations of alcohol consumption.

These conclusions still require further research and validation with larger sample data due to our limitations of having a small sample size and having been a single-center study. Furthermore, the three abovementioned groups of patients shared similar clinical characteristics, including young age, primarily male sex, and serum amylase and lipase levels < 3 times the upper limit of the reference range. For these three types of patients, amylase and lipase values alone are not adequate to provide a basis for the diagnosis of AP, and AP-related abdominal pain and imaging data must be relied on exclusively for diagnosis. Therefore, early imaging studies may be valuable in these three categories of patients to diagnose and to differentially diagnose AP.

The diagnosis of AHAP is characterized by both alcohol and hyperlipidemia, and thus, it has unique clinical manifestations. Alcohol and hyperlipidemia interact in ways that aggravate the severity of AP, possibly because alcoholics often consume high amounts of high-fat, high-protein foods while drinking heavily simultaneously, leading to high TG levels and hypercholesterolemia. While alcohol can damage pancreatic duct epithelial and acinar cells through direct and indirect toxic effects, aggravating inflammation and fibrosis of the pancreas[5,9,10], damage also results from high TG-induced free fatty acid levels and microcirculation disorders that lead to pancreatic ischemia and acidosis[11,12]. Synergies between these pathogenic mechanisms are more likely to cause organ dysfunction in patients and aggravate disease conditions than one etiology on its own. In this study, there were significantly more MSAP and SAP cases in the AHAP group than in the AAP and HLAP groups, and the proportion of antibiotic use was higher in the AHAP group. This suggests that the disease progression should be closely monitored for AHAP patients diagnosed at an early stage. Further, early and effective preventive measures should be taken to reduce the occurrence of complications.

For patients with AHAP, long-term control and management of TG levels and intensive alcohol abstinence are recommended. Controlled carbohydrate and fat intake and increased fiber are recommended for the prevention of fatty liver and diabetes[13,14]. Further, alcohol is not only an independent risk factor for AP, but also induces high triglycerides[15]. Although the AHAP group in this study showed no significant differences in severity or length of hospital stay between the high and low alcohol intake groups, it remains necessary to actively educate patients about health to reduce the harm caused by drinking.

Conclusions

This study compared and analyzed the epidemiological and clinical characteristics of AHAP through a controlled study of three groups of AHAP, AAP, and HLAP cases. We found that patients in the AHAP group were more likely to have a moderate to severe disease course with longer hospital stay. This suggests that AHAP deserves further investigation into being established as its own etiology. As a new AP classification concept, AHAP offers high significance for post-admission diagnosis, early identification of etiologies, removal of etiologies, fluid therapy, nutritional therapy, and prediction of disease progression.

Conflict of Interest

The Authors declare that they have no conflict of interests.

Ethics Approval

This study was reviewed and approved by the Ethical Review Committee of Ordos Central Hospital (No. 202110).

Informed Consent

All patient data were anonymously analyzed using an electronic data acquisition system without informed consent.

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Authors' Contribution

EC, XC, ZS and EM designed the study. PY collected the data. XC analyzed the data and drafted the manuscript. All authors have read and approved the manuscript.

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References

1) NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128.9 million children, adolescents, and adults. Lancet 2017; 390: 2627-2642.
2) Bálint ER, Fűr G, Kiss L, Németh DI, Soós A, Hegyi P, Szakács Z, Tinusz B, Varjú P, Vincze Á, Erőss B, Czimmer J, Szepes Z, Varga G, Rakonczay Z Jr. Assessment of the course of acute pancreatitis in the light of aetiology: a systematic review and meta-analysis. Sci Rep 2020; 10: 17936.
3) Banks PA, Bollen TL, Dervenis C, Gooszen HG, Johnson CD, Sarr MG, Tsiotos GG, Vege SS; Acute Pancreatitis Classification Working Group. Classification of acute pancreatitis--2012: revision of the Atlanta classification and definitions by international consensus. Gut 2013; 62: 102-111.
4) Pelli H, Lappalainen-Lehto R, Piironen A, Sand J, Nordback I. Risk factors for recurrent acute alcohol-associated pancreatitis: a prospective analysis. Scand J Gastroenterol 2008; 43: 614-621.
5) Żorniak M, Sirtl S, Mayerle J, Beyer G. What do we currently know about the pathophysiology of alcoholic pancreatitis: a brief review. Visc Med 2020; 36: 182-190.
6) Herreros-Villanueva M, Hijona E, Bañales JM, Cosme A, Bujanda L. Alcohol consumption on pancreatic diseases. World J Gastroenterol 2013; 19: 638-647.
7) Lee PJ, Papachristou GI. New insights into acute pancreatitis. Nat Rev Gastroenterol Hepatol 2019; 16: 479-496.
8) Munoz MA, Sathyakumar K, Babu BA. Acute pancreatitis secondary to hypertriglyceridemia. Cleve l Clin J Med 2020; 87: 742-750.
9) Lugea A, Gerloff A, Su HY, Xu Z, Go A, Hu C, French SW, Wilson JS, Apte MV, Waldron RT, Pandol SJ. The combination of alcohol and cigarette smoke induces endoplasmic reticulum stress and cell death in pancreatic acinar cells. Gastroenterology 2017; 153: 1674-1686.
10) Pandol SJ, Gorelick FS, Gerloff A, Lugea A. Alcohol abuse, endoplasmic reticulum stress and pancreatitis. Dig Dis 2010; 28: 776-782.
11) Valdivielso P, Ramírez-Bueno A, Ewald N. Current knowledge of hypertriglyceridemic pancreatitis. Eur J Intern Med 2014; 25: 689-694.
12) Guo YY, Li HX, Zhang Y, He WH. Hypertriglyceridemia-induced acute pancreatitis: progress on disease mechanisms and treatment modalities. Discov Med 2019; 27: 101-109.
13) Rawla P, Sunkara T, Thandra KC, Gaduputi V. Hypertriglyceridemia-induced pancreatitis: updated review of current treatment and preventive strategies. Clin J Gastroenterol 2018; 11: 441-448.
14) Yang AL, McNabb-Baltar J. Hypertriglyceridemia and acute pancreatitis. Pancreatology 2020; 20: 795-800.
15) Jo SI, Chang JH, Kim TH, Kim CW, Kim JK, Han SW. Subsets associated with developing acute pancreatitis in patients with severe hypertriglyceridemia and the severity of pancreatitis. Pancreatology 2019; 19: 795-800.