

The Role of the Body Mass Index in the Acute Pancreatitis Evolution

VLAD PADUREANU¹, DAN NICOLAE FLORESCU², RODICA PADUREANU³,
DUMITRU RADULESCU⁴, MIHNEA MARIAN POMACU³, DAN MIHAI FIRU³,
VALERIU MARIN SURLIN⁴

¹Department of Internal Medicine, University of Medicine and Pharmacy of Craiova, Romania

²Department of Gastroenterology, University of Medicine and Pharmacy of Craiova, Romania

³PhD Student, University of Medicine and Pharmacy of Craiova, Romania

⁴Department of Surgery, University of Medicine and Pharmacy of Craiova, Romania

ABSTRACT: The etiological factors involved in acute pancreatitis are multiple, both pancreatic and extra-pancreatic, having a predisposing or triggering role. The purpose of our study was to evaluate the role of BMI (body mass index) in the evolution of acute pancreatitis. The study was performed between January 2018-October 2020 on a lot of 110 patients diagnosed with acute pancreatitis and admitted to the 1stSurgery Clinic and the 2ndMedical Clinic of the Craiova Emergency County Clinical Hospital, the study was prospective. The control lot consisted of patients who were not diagnosed with acute pancreatitis (n=232). Comparing the distributions according to the body mass index of the two groups by the Chi square test, a statistically significant difference is observed (p<0.05) regarding the obese patients who are diagnosed with acute pancreatitis. Obesity patients have an increased risk of developing acute pancreatitis compared to non-obese patients.

KEYWORDS: Body mass index, obesity, acute pancreatitis.

Introduction

Obstruction of the pancreatic bile duct, pancreatic ischemia and activation of pancreatic protease and inflammatory cytokines represent the main causes reported in acute pancreatitis [1,2].

The most frequent etiological factors are gallstones and alcoholism.

There are many factors that influence the incidence of acute pancreatitis, from the geographical and etiological factors to the diagnostic criteria and its accuracy.

The incidence rate of acute pancreatitis is different between different countries of the world, and the results are mainly based on retrospective analyzes of hospitalized patients.

The etiological factors involved in acute pancreatitis are multiple, both pancreatic and extra-pancreatic, having a predisposing or triggering role.

BMI is the most commonly used method for measuring obesity.

It is calculated from a person's weight in kilograms and height in meters (kg/m²).

The values over 30 means obesity.

Patients with a waist circumference greater than 105cm had a 2-fold increase in the risk of acute pancreatitis with a relative risk of 2.37, compared with a waist circumference of 75-85cm.

The severity of acute pancreatitis was increased by obesity [3].

Standards for diagnosing acute pancreatitis were defined in the 2012 International Pancreatology Association (IAP) report "Classification and Definitions of Atlanta (Revised)" [4].

It has been shown that there are several indicators that are important in detecting patients at risk for acute pancreatitis and complications.

These indicators are serum amylase (AMY) [5,6,7], lipase (LIP) [8], low serum ionized calcium (Ca²⁺) [9], high-sensitivity C-reactive protein (hsCRP) [10], neutrophil-lymphocyte ratio (NLR) [11,12], and BMI [13-15].

The purpose of our study was to evaluate the role of BMI (body mass index) in the evolution of acute pancreatitis.

Material and Methods

The study was performed between January 2018-October 2020 on a lot of 110 patients diagnosed with acute pancreatitis and admitted to the 1st Surgery Clinic and the 2ndMedical Clinic of the Craiova Emergency County Clinical Hospital, the study was prospective.

The control lot consisted of patients who were not diagnosed with acute pancreatitis (n=232).

The study design was authorized by the Ethics Committee of the University of Medicine and Pharmacy of Craiova, Romania.

All the patients included in the study signed an informed consent.

From each patient were retained data regarding BMI, CT examination, Balthazar score.

The inclusion criteria for the studied lot were represented by the diagnosis of acute pancreatitis, aged over 18 years.

The exclusion criteria was represented by the age under 18 years.

Inclusion criteria for the control lot of patients were absence of acute pancreatitis diagnosis, socio-economic environment similar to the study group, age-appropriate group and the ratio of men/women to the study group.

The exclusion criteria for the control group were represented by the diagnosis of acute pancreatitis.

BMI (kg/m^2) was calculated based on available data of body weight obtained after admission.

The diagnosis of acute pancreatitis was made if a patient had 2 of the following 3 aspects: (1) sensitivity in the upper abdomen and acute abdominal pain; (2) increased pancreatic enzymes (amylase and lipase) in the blood and urine; and (3) acute pancreatitis identified by ultrasound and abdominal CT examination.

Visceral obesity was established by calculating the waist circumference at the navel, $\geq 85\text{cm}$ for men and $\geq 90\text{cm}$ for women.

Statistical Analysis

For data processing, was used the Microsoft Excel program (Microsoft Corp., Redmond, WA, USA) and for statistical analysis we used the IBM SPSS Statistics 26 program (IBM Corporation, Armonk, NY).

To characterize the data used in the study, we used the following statistical indicators: the average and standard deviation, variation's coefficient, independent t test and Chi square test.

Results

Analyzing the sex distribution of the two groups by the chi-square test, there was no statistically significant difference between them, both groups having a similar gender division.

Although the age division shows differences between the study group and the control group,

the average age of the two groups does not differ significantly.

The study group included patients who smoked more than those in the control group.

The difference observed, 50% versus 37.93%, is statistically significant, the result of the Chi square test being $p=0.010<0.05$.

The etiology of acute pancreatitis is alcoholic in 32.73% of cases (36 patients), lithiasic in 40.91% of cases (45 patients) and idiopathic in 26.36% of cases (29 patients).

To demonstrate the correspondence between the assessment of acute pancreatitis by the Ranson score and the Atlanta classification, we calculated the value of Kappa coefficient for the incidence table which summarizes the link between the two parameters.

The value of the Kappa coefficient was 0.986 (95% CI=0.958-1), indicating an extremely strong correspondence (very important agreement) between the two evaluation modalities.

To demonstrate the correspondence between the assessment of acute pancreatitis by the Ranson score and the Balthazar score, we calculated the value of Kappa coefficient for the incidence table which summarizes the link between the two parameters.

The value of the Kappa coefficient was 0.927 (95% CI=0.854-1), indicating an extremely strong correspondence (very important agreement) between the two evaluation modalities.

To demonstrate the correlation between the assessment of acute pancreatitis by the Balthazar score and the Atlanta classification, we calculated the value of Kappa coefficient for the incidence table which summarizes the link between the two parameters.

The value of the Kappa coefficient was 0.812 (95% CI=0.723-0.901), which indicates a very strong correspondence (important-very important agreement) between the two evaluation modalities.

The distribution of patients according to the body mass index for the two groups is illustrated in Figure 1 and Table 1.

Comparing the distributions according to the body mass index of the two groups by the chi-square test, a statistically significant difference is observed ($p<0.05$) regarding obese patients who are diagnosed with acute pancreatitis.

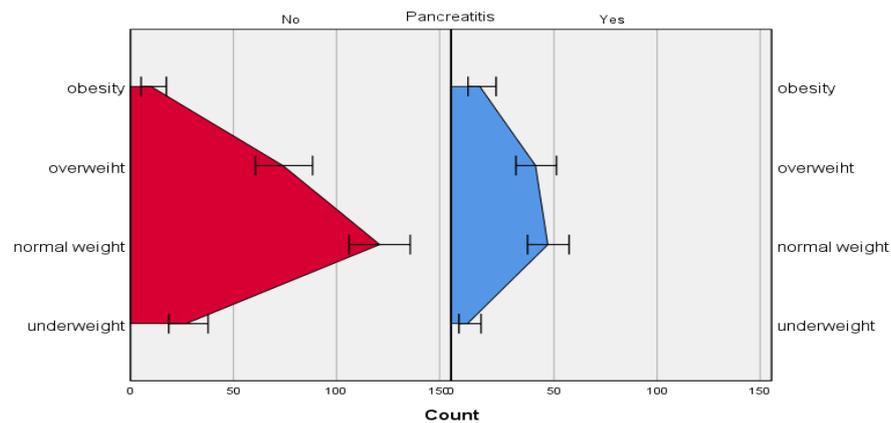


Figure 1. Distribution of the patients according to BMI.

Table 1. Distribution of patients according to the BMI.

		underweight	normal weight	overweight	obesity
Pancreatitis	Yes	8 7.3%	47 42.7%	41 37.3%	14 12.7%
	No	27 11.6%	121 52.2%	74 31.9%	10 4.3%

To confirm the statistical significance of the increase in Balthazar score in obese patients, in addition to the Kappa coefficient, we performed the independent t test by comparing the means of the Balthazar score between the group of non-obese and obese patients.

We considered the results to be statistically significant if the P values on the two groups were <0.05, with a 95% confidence interval.

Table 2. Comparison of the average Balthazar score between obese and non-obese patients.

	Balthazar A	Balthazar B	Balthazar C	Balthazar D	Balthazar E	p value
No Obesity	24	21	19	18	14	-
Obesity I	1	1	1	0	0	0.353
Obesity II	0	0	1	2	2	0.025*
Obesity III	0	1	1	0	4	0.018*
Obesity total	1	2	3	2	6	0.019*

*p<05-statistically significant-independent t test

Increasing the grade of obesity, a higher incidence of high-grade Balthazar score is observed, being statistically significantly higher in patients with Balthazar II score (p=0.025) and Balthazar III (p=0.019) compared to Balthazar score on non-obese patients.

Also, considering the whole group of obese patients, a high grade Balthazar score is observed, compared to the Balthazar score in non-obese patients, with statistical significance (p=0.019) (Table 2).

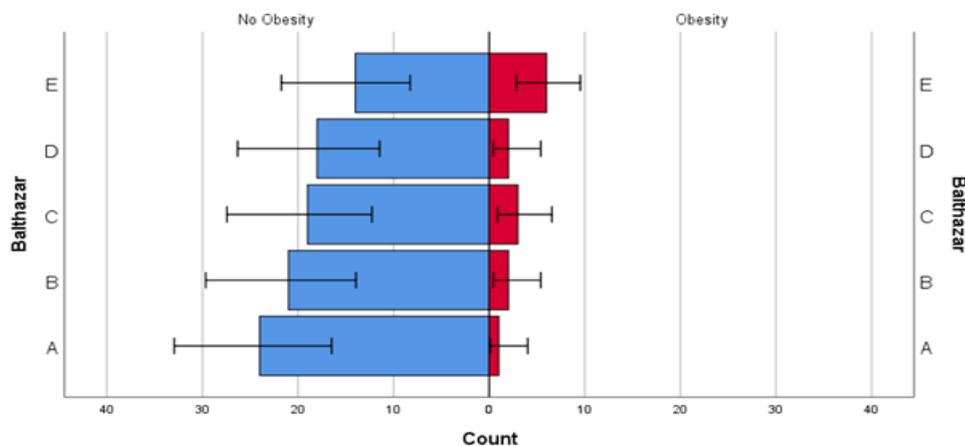


Figure 2. Balthazar score according to the presence or absence of the obesity.

There is also a higher number of patients with BP who have a higher Balthazar score in

the group of obese patients compared to the group of non-obese patients (Figure 2).

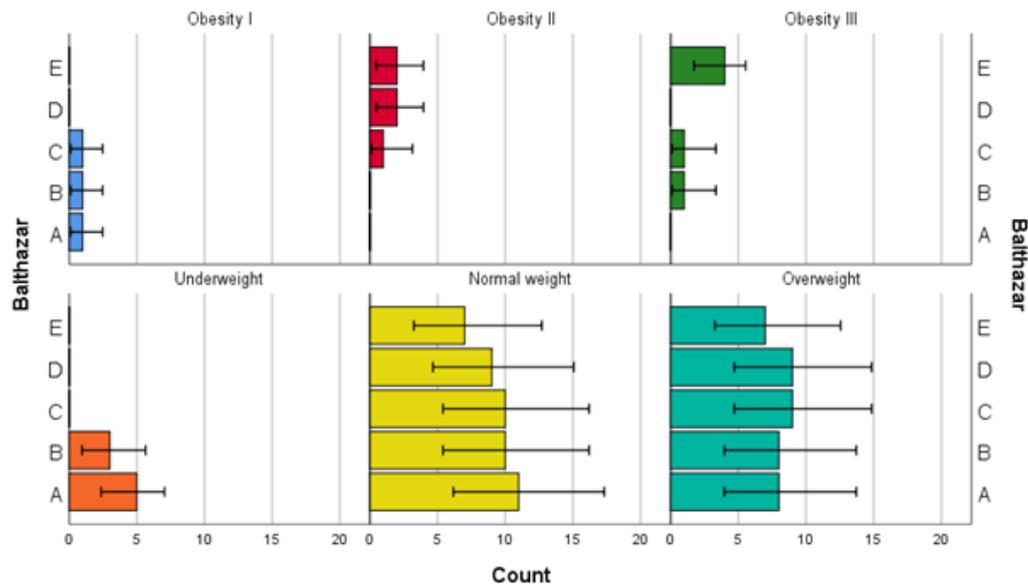


Figure 3. Balthazar score according to the degree of obesity.

Analyzing each degree of obesity according to the severity of BP highlighted by the Balthazar score, an increase in its severity is observed in patients with grade II obesity, with very high severity in patients with grade III obesity (Figure 3).

Discussion

In the last decade, the rate of acute pancreatitis has increased by at least 20% worldwide [16,17].

Studies have shown that a risk factor for severe acute pancreatitis is BMI [14].

BMI greater than 30kg/m² can double the risk of mortality, and triple the risk of severe acute pancreatitis [15].

The increase in BMI has been correlated with a higher incidence of chronic diseases, such as hypertension, cholecystitis, biliary disease and hyperlipidemia, diseases that can contribute to the appearance and exacerbation of acute pancreatitis [16].

Regarding the etiology of acute pancreatitis, patients with high BMI had a higher incidence rate of gallstones as a cause of acute pancreatitis, compared to those with low BMI.

The guidelines for the management of acute pancreatitis recommend the inclusion of BMI in the prediction of the severity of acute pancreatitis, according to literature data on studies in non-Asian countries [18].

The mechanisms by which obesity increases the severity of acute pancreatitis have been

clarified from clinical trials and animal models of acute pancreatitis.

Adipose tissue can be considered an important source of pro-inflammatory cytokines, including interleukin-6 and tumor necrosis factor- α [19], so large amounts of pro-inflammatory cytokines are released from adipose tissue when acute pancreatitis develops in obese patients.

The release of pro-inflammatory cytokines leads to the activation of the SIRS cascade, which may increase the risk of developing organ failure [7,19].

Conclusions

Our study demonstrated the negative impact of a high BMI on the prognosis of PA.

The BMI value $\geq 25\text{kg/m}^2$, led to poor results among patients with acute pancreatitis, so it can be considered a negative prognostic marker.

Acute pancreatitis also has a higher risk of developing in obese patients.

Our study presents certain limitations that should be considered, such as performing in a single center and the fact that no observations were made in dynamics and also the lack of analysis of indicators in the severity of the disease.

Along these lines, it is necessary to conduct additional prospective and multicenter studies with large groups of patients to optimize the diagnosis and treatment of acute pancreatitis in clinical practice.

Acknowledgements

Vlad Padureanu and Dan Nicolae Florescu contributed equally to preparing this paper and share first authorship.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interests

None to declare.

References

- Ozhan G, Sari FM, Vefai M, Yanar HT, Alpertunga B. Acute pancreatitis is associated with Ser608Leu1NOS polymorphism. *Folia Biol*, 2012, 58(6):256-260.
- Pădureanu V, Boldeanu MV, Streața I, Cucu MG, Siloși I, Boldeanu L, Bogdan M, Enescu AȘ, Forțoiu M, Enescu A, Dumitrescu EM, Alexandru D, Șurlin VM, Forțoiu MC, Petrescu IO, Petrescu F, Ioana M, Ciurea ME, Săftoiu A. Determination of VEGFR-2 (KDR) 604A>G Polymorphism in Pancreatic Disorders. *Int J Mol Sci*, 2017, 18(2):439.
- Yadav D, Lowenfels AB. The epidemiology of pancreatitis and pancreatic cancer. *Gastroenterology*, 2013, 144(6):1252-1261.
- 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(1):102-111.
- Wang CY, Zhao L, Hong YP, Mei FC, Zhou Y, Shi Q, Guo WY, Deng WH, Chen C, Yu J, Wang WX. Serum thyroid hormones levels are significantly decreased in pregnant rats with acute pancreatitis. *Biochem Biophysical Res Commun*, 2018, 505(3):657-663.
- Ikeura T, Kato K, Takaoka M, Shimatani M, Kishimoto M, Nishi K, Kariya S, Okazaki K. A body mass index ≥ 25 Kg/M² is associated with a poor prognosis in patients with acute pancreatitis: a study of Japanese patients. *Hepatobiliary Pancreat Dis Int*, 2017, 16(6):645-651.
- Yu S, Wu D, Jin K, Yin L, Fu Y, Liu D, Zhang L, Yu X, Xu J. Low Serum Ionized Calcium, Elevated High-Sensitivity C-Reactive Protein, Neutrophil-Lymphocyte Ratio, and Body Mass Index (BMI) Are Risk Factors for Severe Acute Pancreatitis in Patients With Hypertriglyceridemia Pancreatitis. *Med Sci Monit*, 2019, 25:6097-6103.
- Nie S, Cui X, Guo J, Ma X, Zhi H, Li S, Li Y. Inhibiting role of rosiglitazone in the regulation of inflammatory response and protective effects for severe acute pancreatitis in mice. *J Cell Biochem*, 2019, 120(1):799-808.
- Huai J, Shao Y, Sun X, Jin Y, Wu J, Huang Z. Melatonin ameliorates acute necrotizing pancreatitis by the regulation of cytosolic Ca²⁺+homeostasis. *Pancreatol*, 2012, 12(3):257-263.
- Cao X, Wang HM, Du H, Chen EX, Yang XF, Wang SL, Ding Y, She ZF. Early predictors of hyperlipidemic acute pancreatitis. *Exp Ther Med*, 2018, 16(5):4232-4238.
- Abayli B, Gencdal G, Degirmencioglu S. Correlation between neutrophil/lymphocyte ratio and Ranson score in acute pancreatitis. *J Clin Lab Anal*, 2018, 32(6):e22437.
- Chooklin S, Chuklin S, Shershen G, Popyk P. Neutrophil-lymphocyte ratio in acute pancreatitis: Diagnostic and prognostic role. *Pancreas*, 2018, 47(10):1379.
- Fei Y, Gao K, Tu J, Wang W, Zong GQ., Li WQ. Predicting and evaluation the severity in acute pancreatitis using a new modeling built on body mass index and intra-abdominal pressure. *Am J Surg*, 2018, 216(2):304-309.
- Martinez J, Johnson CD, Sanchez-Paya J, De Madaria E, Robles-Diaz G, Perez-Mateo M. Obesity is a definitive risk factor of severity and mortality in acute pancreatitis: An updated meta-analysis. *Pancreatol*, 2006, 6(3):206-209.
- Lankisch PG, Schirren CA. Increased body weight as a prognostic parameter for complications in the course of acute pancreatitis. *Pancreas*, 1990, 5(5):626-629.
- Hazra N, Gulliford M. Evaluating pancreatitis in primary care: A population-based cohort study. *Brit J Gen Pract*, 2014, 64(622):e295-301.
- Spanier BWM, Bruno MJ, Dijkgraaf MGW. Incidence and mortality of acute and chronic pancreatitis in the Netherlands: A nationwide record-linked cohort study for the years 1995-2005. *World J Gastroenterol*, 2013, 19(20):3018-3026.
- Takeda K, Yokoe M, Takada T, Kataoka K, Yoshida M, Gabata T, Hirota M, Mayumi T, Kadoya M, Yamanouchi E, Hattori T, Sekimoto M, Amano H, Wada K, Kimura Y, Kiriya S, Arata S, Takeyama Y, Hirota M, Hirata K, Shimosegawa T. Assessment of severity of acute pancreatitis according to new prognostic factors and CT grading. *J Hepatobiliary Pancreat Sci*, 2010, 17(1):37-44.
- Sempere L, Martinez J, De Madaria E, Lozano B, Sanchez-Paya J, Jover R, Perez-Mateo M. Obesity and fat distribution imply a greater systemic inflammatory response and a worse prognosis in acute pancreatitis. *Pancreatol*, 2008, 8(3):257-264.

Corresponding Authors: Rodica Pădureanu, PhD student, University of Medicine and Pharmacy of Craiova, 2 Petru Rares Str., 200349, Craiova, Romania, e-mail: zegheanurodica@yahoo.com

Dumitru Radulescu, University of Medicine and Pharmacy of Craiova, Surgery Department, 2 Petru Rares Str, Craiova 200349, Romania, e-mail: dr_radulescu_dumitru@yahoo.com