Original Article

J Korean Soc Radiol 2020;81(6):1436-1447
https://doi.org/10.3348/jksr.2020.0012
pISSN 1738-2637 / eISSN 2288-2928

대한영상의학회지

Prediction of Necrotizing Pancreatitis on Early CT Based on the Revised Atlanta Classification

개정된 아틀란타 분류법에 근거한 초기 CT에서의 괴사성 췌장염의 예측

Yeon Seon Song, MD, Hee Sun Park, MD*, Mi Hye Yu, MD, Young Jun Kim, MD, Sung Il Jung, MD

Department of Radiology, Konkuk University School of Medicine, Seoul, Korea

Purpose To investigate the clinical and CT features at admission to predict the progression to necrotizing pancreatitis (NP) in patients initially diagnosed with interstitial edematous pancreatitis (IEP).

Materials and Methods Patients with IEP who underwent contrast-enhanced CT at admission and follow-up CT (< 14 days) were included (n = 178). Two radiologists performed a consensus review of follow-up CT scans and diagnosed the type of acute pancreatitis as IEP or NP. Laboratory findings at admission were recorded. Clinical, CT, and laboratory findings were compared between the IEP-IEP group and IEP-NP group using the chi-square test and the t-test. Multivariate analysis was also performed.

Results There were 112 and 66 patients in the IEP-IEP and the IEP-NP groups, respectively. The proportion of patients with alcohol etiology was significantly larger in the IEP-NP group. Among the CT findings, the presence of peripancreatic fluid and heterogeneous parenchymal enhancement were more frequently observed in the IEP-NP group. Among the laboratory variables, serum C-reactive protein levels and white blood cell counts were significantly higher in the IEP-NP group. Multivariate analysis revealed that the presence of peripancreatic fluid and heterogeneous parenchymal enhancement were significant findings distinguishing the two groups.

Conclusion CT findings, such as the presence of peripancreatic fluid and heterogeneous pancreatic parenchymal enhancement, may be helpful in predicting the progression to NP in patients initially diagnosed with IEP.

Index terms Acute Pancreatitis; Acute Edematous Pancreatitis; Acute Necrotizing Pancreatitis; Pancreatic Necrosis; Peripancreatic Fat Necrosis; Computed Tomography, X-Ray

Received January 22, 2020
Revised February 14, 2020
Accepted March 5, 2020

***Corresponding author**
Hee Sun Park, MD
Department of Radiology,
Konkuk University
School of Medicine,
120-1 Neungdong-ro,
Gwangjin-gu, Seoul 05030, Korea.

Tel 82-2-2030-5497
Fax 82-2-2030-5549
E-mail heesun.park@gmail.com

ORCID iDs
Yeon Seon Song
https://orcid.org/0000-0002-1083-9323
Hee Sun Park
https://orcid.org/0000-0003-0869-269X
Mi Hye Yu
https://orcid.org/0000-0003-0519-7853
Young Jun Kim
https://orcid.org/0000-0002-9276-1266
Sung Il Jung
https://orcid.org/0000-0002-4588-209X

INTRODUCTION

Acute pancreatitis is an acute inflammatory condition of the pancreas, with various disease severities and local and systemic complications (1). The diagnosis of acute pancreatitis is made when two of the following three features are present: 1) abdominal pain compatible with acute pancreatitis (acute onset of persistent and severe epigastric pain radiating to the back); 2) serum lipase or amylase activity at least three times greater than the upper normal limit); and 3) characteristic findings of acute pancreatitis on imaging such as contrast-enhanced CT, or less commonly, MRI, or ultrasonography (2, 3).

According to the revised Atlanta classification, acute pancreatitis is subdivided into two types: interstitial edematous pancreatitis (IEP) and necrotizing pancreatitis (NP) (2). In IEP, diffuse pancreatic enlargement, relatively homogenous or mildly heterogeneous parenchymal enhancement, or peripancreatic fat stranding or fluid can be seen on contrast-enhanced CT. IEP responds well to supportive care, and its clinical course is mild and self-limiting, lasting no longer than 2 weeks (4, 5). In NP, which accounts for approximately 5–10% of acute pancreatitis, necrosis of the pancreatic parenchyma, peripancreatic fat, or both can occur (2). It has a more severe clinical course lasting weeks to months and can lead to multi-organ failure, requiring extensive monitoring and intensive therapy (5, 6).

The utility and clinical yield of CT in the early phase are under debate, and there has been no consensus on CT as a prognostic indicator in the early course of acute pancreatitis (7-10). However, contrast-enhanced CT occasionally plays a role in excluding alternative serious abdominal conditions causing abdominal pain and serum lipase or amylase activity similar to acute pancreatitis, such as bowel perforation (7, 11, 12). Moreover, contrast-enhanced CT provides information on the etiology of acute pancreatitis, such as biliary stone disease, pancreas anomaly or hidden malignancy, alcoholic liver disease, and etc. Owing to the aforementioned reasons, patients with acute pancreatitis frequently undergo contrast-enhanced CT in an early phase.

Although IEP based on the criteria proposed by the revised Atlanta classification shows a mild and self-limiting disease course, we encountered some patients in our clinical practice who were diagnosed with IEP at the initial CT scan were later diagnosed with NP at a short-term follow-up CT scan. In this regard, questions were raised on whether the progression to NP can be predicted in these patients or not.

Therefore, the objective of this study was to investigate the clinical and CT features on the initial CT scan at admission to predict the progression to NP, in patients initially diagnosed with IEP.

MATERIALS AND METHODS

PATIENTS

Our Institutional Review Board approved this study and, waived the requirement of informed consent owing to its retrospective nature (IRB No. KUMC 2020-01-004).

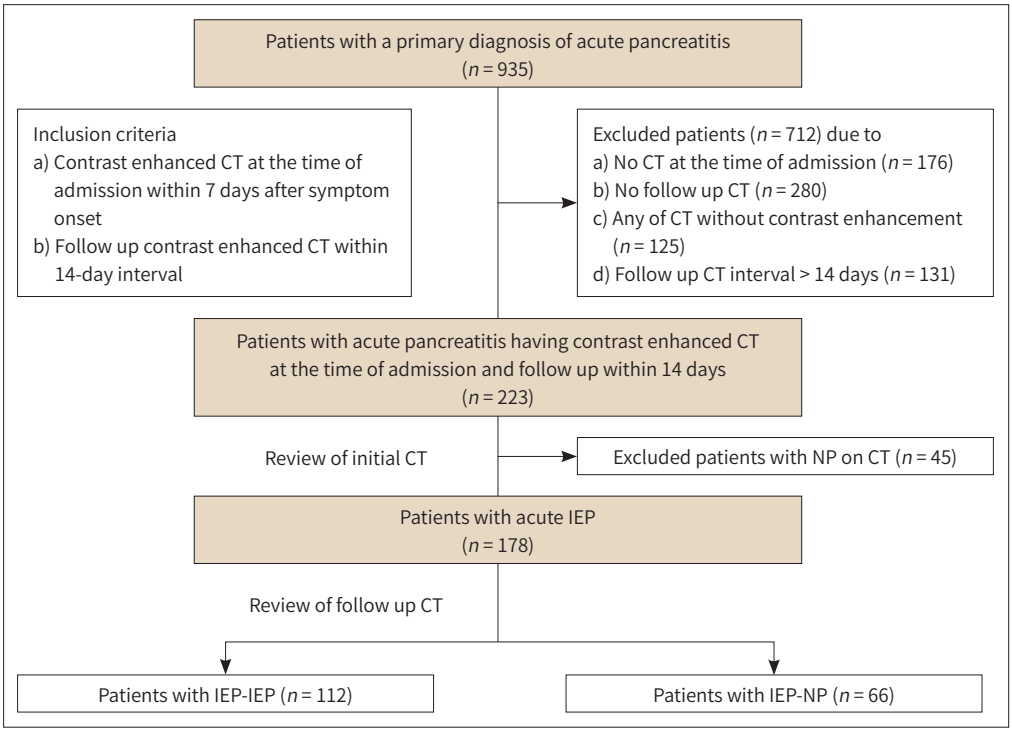
By query of our institutional database, in the period from September 2008 to August 2018, we identified 935 consecutive patients with a primary diagnosis of acute pancreatitis (Interna-

tional Classification of Diseases-10 codes: K85, K85-001, K850, K851, K851-001, K853, K858, and K859). Inclusion criteria were: 1) patients who underwent contrast-enhanced CT scan at the initial imaging workup within 7 days after symptom onset; 2) and patients who underwent follow-up contrast-enhanced CT scan within a 14-day interval. Based on the initial inclusion criteria, 712 patients were excluded as follows: 1) 176 patients who did not undergo CT at the time of admission; 2) 280 patients who did not undergo any follow-up CT; 3) 125 patients of whom either the initial or follow-up CT scan was not performed with contrast enhancement; 4) 131 patients for whom follow-up CT within 14 days were not available.

For the remaining 223 patients, the initial CT scan was reviewed, and patients who were diagnosed with NP (n = 45) were additionally excluded (methodology regarding CT imaging diagnosis is described in detail in the Methods section later).

Finally, 178 patients with IEP were included in our study [121 men, 57 women; mean age ± standard deviation (SD), 55.4 ± 16.12 years; age range, 22–98 years]. The etiology of the acute pancreatitis was as follows: alcohol (n = 101), biliary stones (n = 38), post-endoscopic retrograde cholangio-pancreatography (n = 10), pancreatobiliary malignancy [n = 5; pancreatic cancer (n = 3), distal common bile duct cancer (n = 1), intraductal papillary mucinous tumor (n = 1)], developmental anomaly [n = 4, pancreas divisum (n = 3), choledochal cyst (n = 1)], post-operative [(n = 4); Whipple's operation (n = 2), pylorus-preserving pancreatoduodenectomy (n = 1), ampullectomy (n = 1)], chronic pancreatitis [n = 4; pancreaticolith (n = 2), pancreatic ductal stricture (n = 2)], drug (n = 1), trauma (n = 1), and unknown (n = 10). Fig. 1 shows a flow chart of the patient population and study design.

Fig. 1. Flow chart of the patient population and study design.



IEP = interstitial edematous pancreatitis, NP = necrotizing pancreatitis

CT TECHNIQUE

CT scans were performed using one of the four types of multi-detector row CT scanners: 64- (Somatom Definition, Siemens Medical Systems, Erlangen, Germany; LightSpeed VCT XT; GE Healthcare, Milwaukee, WI, USA) or 16-(LightSpeed Pro 16; GE Healthcare) channel CT. The Siemens scanner was set to have the following parameters: detector collimation = 64 × 0.625 mm; helical pitch = 0.984; 120 kVp, automated dose modulation using maximum allowable tube current set at 200 mAs, section thickness/interval = 3/3 mm. GE scanners were set to the following parameters: detector collimation = 64 × 0.625 mm and 16 × 1.25 mm, beam pitch = 0.984 and 0.938; section thickness/interval = 3.75/3.75 mm; 120 kVp / 300–500 mAs and 120 kVp / 200–400 mAs, respectively. CT protocols were triple-phase dynamic CT (*n* = 103) or single portal phase CT (*n* = 75). Unenhanced scans were obtained, followed by arterial, portal, and delayed phase scans using a 15-s delay after the attenuation of the aorta at the thoracolumbar junction had reached 100 HU (arterial phase), a fixed 80-s delay (portal phase) and 3-min delay (delayed phase), respectively, after an intravenous injection of 150 mL of iopromide (Ultravist 370; Bayer Schering Pharma, Berlin, Germany) administered at a rate of 3 mL/s with an autonomic injector. Coronal reformatted images were created using the source CT dataset, with slice thickness and reconstruction interval set to be 3 mm.

IMAGE ANALYSIS

All CT images were reviewed retrospectively and independently on a picture archiving and communication system workstation (Centricity; GE Healthcare) by two radiologists (H.S.P. and M.H.Y., with 14 and 10 years of experience in abdominal radiology, respectively). Discrepancies in the interpretation were resolved by a third radiologist (Y.J.K., with 18 years of experience in abdominal radiology), who conducted a consensus review of each case. Ultimately, these consensus interpretations were used for the image analysis. All radiologists were aware that all of the patients had been diagnosed with acute pancreatitis but were blinded to information on the clinical follow-up.

Images were interpreted in two sessions. In the first session, initial CT images (*n* = 223) were reviewed, and the diagnosis were obtained as IEP or NP, according to the definition proposed by the revised Atlanta classification (2). In IEP, the pancreatic parenchyma shows relatively homogeneous or mildly heterogeneous enhancement, and the peripancreatic fat shows haziness or stranding. The peripancreatic fluid (acute peripancreatic fluid collections) can be seen, which does not have a well-defined wall, has homogeneous fluid density, is confined by normal retroperitoneal fascial planes, and may be multiple (2). NP manifests as necrosis involving the pancreas, peripancreatic fat tissue, or both. Pancreatic necrosis is defined as a sharply demarcated region of the pancreatic parenchyma that does not enhance after intravenous administrations of contrast material (13, 14). Acute pancreatic or peripancreatic necrotic collections show heterogeneous density on CT because they contain varying amounts of solid necrotic material and fluid. They can be multiple and loculated (1).

After the diagnoses were obtained, reviewers evaluated the presence or absence of specific CT imaging findings in patients who were diagnosed with IEP (*n* = 178): peripancreatic fluid collections; peripancreatic haziness and fat stranding; heterogeneous density of the pancreatic parenchyma without necrosis in the portal venous phase; dilatation of the main pancreatic

duct; dilatation of the bile duct; underlying chronic pancreatitis; lymphadenopathy; narrowing/obliteration or thrombosis of the superior mesenteric vein or splenic vein. In the second session, follow-up CT images of patients diagnosed with IEP (n = 178) were reviewed. Radiologists determined the diagnosis of each CT set as IEP or NP based on the same CT diagnostic criteria as the first review session. To minimize recall bias, each image interpretation session was maintained at an interval of at least 2-weeks. According to the initial and follow-up CT diagnoses, patients were categorized under the IEP-IEP or IEP-NP group.

LABORATORY EXAMINATION

Laboratory data, including serum level of amylase, lipase, C-reactive protein, white blood cell count, albumin, total bilirubin, aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase, blood urea nitrogen, creatinine, and phosphorus at the time of initial CT were obtained through the retrospective review of electronic medical records.

STATISTICS

Categorical variables (i.e., CT imaging findings, patients' sex, and etiology of acute pancreatitis) are expressed as numbers and percentages and compared between the IEP-IEP and IEP-NP groups using the chi-square test. Quantitative variables (laboratory exams and patients' age) are expressed as mean ± SD and compared between the two patient groups using the t-test. The variables found to have statistical significance in a univariate analysis were entered into a multivariate logistic regression analysis to identify the useful parameters to predict IEP-NP. p-values less than 0.05 were considered to indicate a statistically significant difference. All statistical analyses were performed using commercially available software programs (MedCalc, version 19.1.3, MedCalc Software, Mariakerke, Belgium).

RESULTS

PATIENT CHARACTERISTICS

The time interval between the symptom onset and the initial CT scan was 1 ± 1.72 days (range: 0–7 days), and the time interval between the initial and follow-up CT scans was 6.74 ± 3.2 days (range: 1–14 days). At the short-term follow-up, 66 patients (37.1%) were diagnosed with NP while stationary or improved IEP was observed in the remaining 112 patients (62.9%). Interval period between the two CT scans was 6.85 ± 3.5 days (range: 1–14 days) in IEP-IEP group and 6.58 ± 2.6 days (range: 1–13 days) in IEP-NP group (p = 0.5848).

COMPARISON OF CLINICAL FINDINGS BETWEEN THE TWO GROUPS

Patients' mean age and sex distributions between the two groups were not significantly different. However, distribution of the etiology was different between the two groups. In the IEP-IEP group, alcoholic cause was seen in 52.7% (59/112) and biliary stone in 26.8% (30/112). In the IEP-NP group, alcoholic cause was seen in 63.6% (42/66) and biliary stone was in 12.1% (8/66), suggesting that the proportion of alcoholic cause was larger in the IEP-NP group (p = 0.251) (Table 1).

COMPARISON OF CT FINDINGS BETWEEN THE TWO GROUPS

Among the CT imaging analysis variables, the presence of peripancreatic fluid was more frequently observed in the IEP-NP group (98.5%, 65/66) than in the IEP-IEP group (68.7%, 77/112) ($p < 0.0001$). The heterogeneous enhancement of the pancreatic parenchyma was also more frequently seen in the IEP-NP group (72.7%, 48/66) than in the IEP-IEP group (40.2%, 45/112) ($p < 0.0001$) (Figs. 2, 3) (Table 2).

Table 1. Comparison of Patients' Characteristics and Etiology of Acute Pancreatitis between the Two Groups

Characteristics	IEP-IEP (*n* = 112)	IEP-NP (*n* = 66)	*p*-Value
Sex, male/female	75/37	46/20	0.7066
Age, mean ± SD	56.1 ± 15.0	54.4 ± 18.0	0.5
Etiology			
Alcoholics (*n* = 101)	59 (52.7)	42 (63.6)	0.0251
Gallstone (*n* = 38)	30 (26.8)	8 (12.1)	
Post-endoscopic retrograde cholangio-pancreatography (*n* = 10)	4 (3.6)	6 (9.1)	
Pancreatobiliary malignancy (*n* = 5)	3 (2.7)	2 (3.0)	
Developmental anomaly (*n* = 4)	4 (3.6)	0 (0)	
Post-operative (*n* = 4)	3 (2.7)	1 (1.5)	
Chronic pancreatitis (*n* = 4)	2 (1.8)	2 (3.0)	
Drug (*n* = 1)	1 (0.9)	0 (0)	
Trauma (*n* = 1)	0 (0)	1 (1.5)	
Unknown (*n* = 10)	6 (5.4)	4 (6.1)	

Data are mean ± SD or *n* (%) values.
IEP = interstitial edematous pancreatitis, NP = necrotizing pancreatitis, SD = standard deviation

Fig. 2. A representative case of IEP-NP group.
A. Contrast-enhanced CT at admission shows heterogeneous density of the pancreatic parenchyma (arrow) and a small amount of homogeneous peripancreatic fluid around the pancreas head (arrowhead) that suggested acute IEP.
B. Follow-up CT obtained 8 days later shows acute necrotic collection (arrowheads) and pancreatic parenchymal necrosis (arrow), indicating NP.
IEP = interstitial edematous pancreatitis, NP = necrotizing pancreatitis

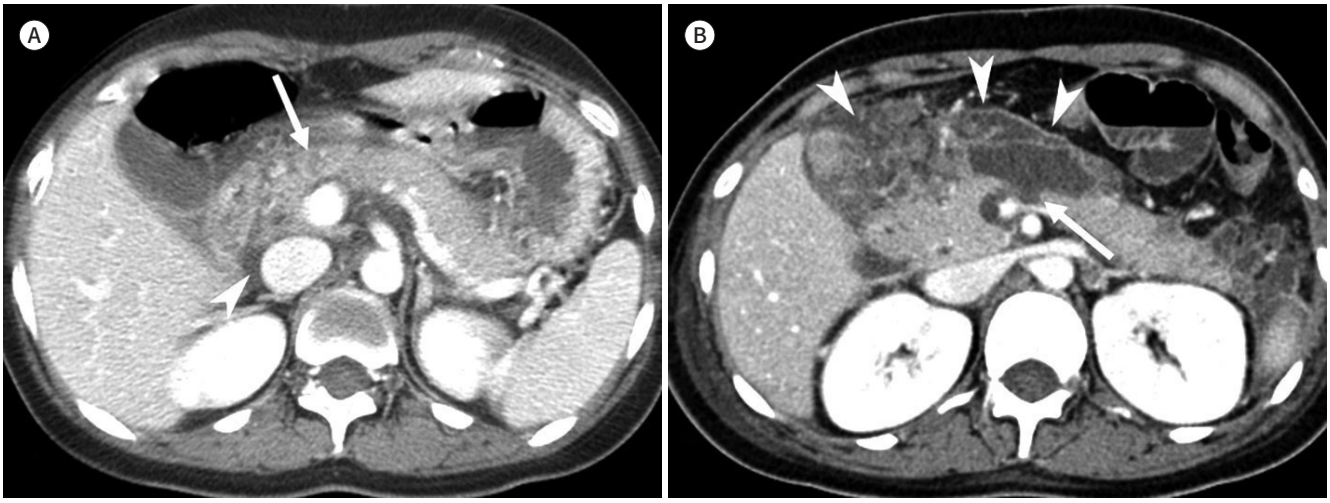


Fig. 3. A representative case of IEP-NP group.
A. Contrast-enhanced CT at admission shows heterogeneous density of the pancreatic parenchyma (arrow) and peripancreatic fat stranding (arrowheads) that suggested acute IEP.
B. Follow-up CT obtained 8 days later shows a newly developed nonenhancing portion in the pancreas head (arrows), indicating parenchymal necrosis in NP.
IEP = interstitial edematous pancreatitis, NP = necrotizing pancreatitis

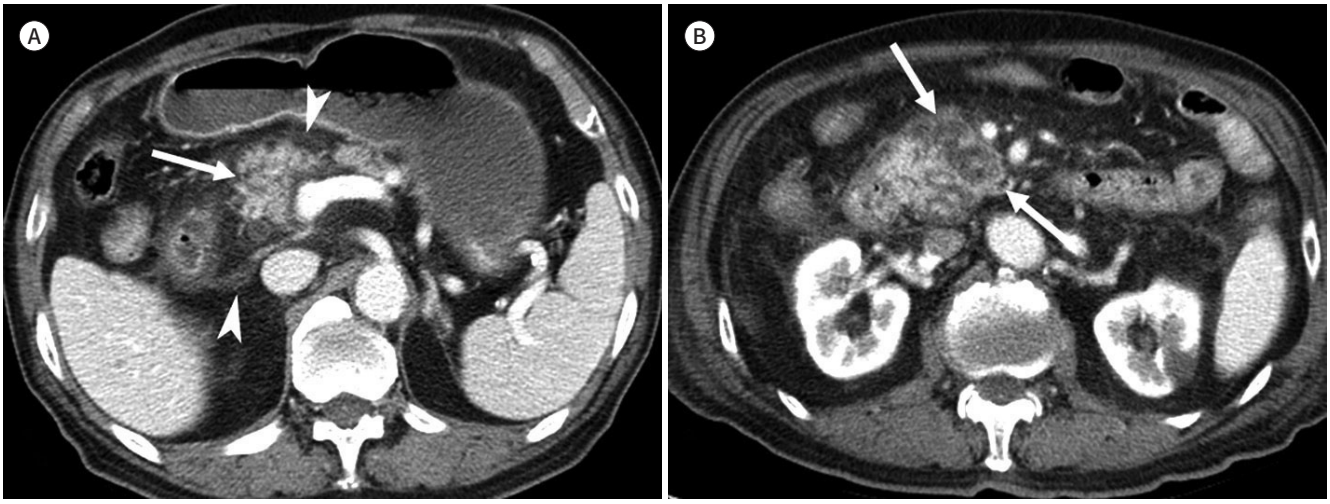


Table 2. Comparison of CT Findings between the Two Groups

CT Findings	IEP-IEP (*n* = 112, %)	IEP-NP (*n* = 66, %)	*p*-Value
Peripancreatic fluid	77/112 (68.7)	65/66 (98.5)	< 0.0001
Peripancreatic fat stranding	99/112 (88.4)	63/66 (95.5)	0.1126
Heterogeneous parenchymal enhancement	45/112 (40.2)	48/66 (72.7)	< 0.0001
Dilatation of main pancreatic duct	20/112 (17.9)	6/66 (9.1)	0.1107
Dilatation of bile duct	30/112 (26.8)	11/66 (16.7)	0.1225
Underlying chronic pancreatitis	17/112 (15.2)	4/66 (6.1)	0.0693
Lymphadenopathy	79/112 (70.5)	53/66 (80.3)	0.1516
Narrowing or thrombosis of superior mesenteric vein/splenic vein	12/112 (10.7)	8/66 (12.1)	0.7747

IEP = interstitial edematous pancreatitis, NP = necrotizing pancreatitis

COMPARISON OF LABORATORY FINDINGS BETWEEN THE TWO GROUPS

Among the laboratory variables, the C-reactive protein level (normal range: 0.01–0.3 mg/dL) at admission was significantly higher in the IEP-NP group (7.8 ± 11.23 mg/dL) than in the IEP-IEP group (4.1 ± 7.22 mg/dL) ($p = 0.009$), and white blood cell count (normal range 4–10 × 10^3/μL) was also significantly higher in the IEP-NP group [(13.4 ± 4.15) × 10^3/μL] than in IEP-IEP group [(11.8 ± 5.08) × 10^3/μL] ($p = 0.034$) (Table 3).

MULTIVARIATE ANALYSIS

Multivariate logistic regression analysis was performed using the statistically significant variables from the univariate analysis [presence of peripancreatic fluid, heterogeneous enhancement of the pancreatic parenchyma, etiology of acute pancreatitis (alcohol vs. biliary stone), serum level of C-reactive protein and white blood cell count at admission]. As a result, the presence of peripancreatic fluid ($p = 0.0066$, odds ratio: 17.32) and heterogeneous paren-

Table 3. Comparison of Laboratory Exam Findings between the Two Groups

Laboratory Variables	IEP-IEP (*n* = 112)	IEP-NP (*n* = 66)	*p*-Value
Amylase (U/L)	829.1 ± 1029.96	761.3 ± 898.08	0.659
Lipase (U/L)	4181.7 ± 8431.69	2809.9 ± 4218.78	0.22
C-reactive protein (mg/dL)	4.1 ± 7.22	7.8 ± 11.23	0.009
White blood cell counts (× 10^3/μL)	11.8 ± 5.08	13.4 ± 4.15	0.034
Albumin (g/dL)	3.9 ± 0.68	3.9 ± 0.66	0.998
Total bilirubin (mg/dL)	1.6 ±1.93	1.4 ±1.71	0.556
AST (IU/L)	197.9 ± 440.69	164.7 ± 560.19	0.664
ALT (IU/L)	125.5 ± 276.34	199.1 ± 851.63	0.405
Alkaline phosphatase (IU/L)	103.5 ± 59.88	98.5 ± 57.12	0.585
Blood urea nitrogen (mg/dL)	17.0 ± 11.05	19.6 ± 14.03	0.168
Creatinine (mg/dL)	1.0 ± 0.68	1.1 ± 0.71	0.742

ALT = alanine aminotransferase, AST = aspartate aminotransferase, IEP = interstitial edematous pancreatitis, NP = necrotizing pancreatitis

Table 4. Multiple Logistic Regression Analysis for Prediction of Necrotizing Pancreatitis

Parameters	Odds Ratio	95% CI	*p*-Value
Peripancreatic fluid	17.3233	2.2164–135.3962	0.0066
Heterogeneous enhancement of pancreatic parenchyma	2.8336	1.2985–6.1836	0.0089
Etiology	1.0805	0.9120–1.2801	0.3706
Serum C-reactive protein	1.0408	0.9983–1.0851	0.0602
White blood cell count	1	0.9999–1.0001	0.7411

CI = confidence interval

chymal enhancement (p = 0.0089, odds ratio: 2.83) were found to be the statistically significant factors predicting IEP-NP (Table 4).

DISCUSSION

NP is a severe form of acute pancreatitis, including pancreatic gland necrosis and/or peripancreatic fat necrosis (2). It is associated with high rates of morbidity (34–95%) and mortality (2–39%) (15). Mortality within the first 2 weeks of onset is mostly associated with the systemic inflammatory response syndrome that can lead to systemic organ dysfunction, immuno-suppression, and transient or persistent organ failure (16). The revised Atlanta classification established a clear distinction between the two categories of acute pancreatitis, IEP and NP, based on contrast-enhanced CT or magnetic resonance imaging findings (1, 2).

However, the diagnosis of NP based on imaging in its early phase is found to be frequently challenging in the clinical practice. Our study results demonstrated that out of the patients who had been initially diagnosed with IEP at admission, approximately 37% (66/178) had eventually progressed to NP on follow-up imaging. The clinical implications of imaging early in the course of acute pancreatitis has been questioned. According to a multicenter observational study conducted by Spanier et al. (7), Balthazar CT scores in the early phase (within 4 days of symptom onset) were not significantly different between mild and severe acute pancreatitis.

In addition, the study showed that in patients with severe acute pancreatitis who ultimately developed NP, no pancreatic necrosis was detected on early CT (7); the result is consistent with that of our study. The severity of acute pancreatitis is determined mainly by the presence of systemic inflammatory response syndrome and organ failure in the early clinical phase (< 1 week of disease onset). Because early morphologic changes in images poorly correlate with clinical findings and are therefore of little help to predict the subsequent clinical course, sensitivity of early CT for NP decreases, and the role of imaging may be limited to the early phase (1, 17).

From this perspective, we tried to investigate whether NP can be predicted on early CT or not. In our study, the presence of peripancreatic fluid and heterogeneous contrast-enhancement of the pancreatic parenchyma were found to be the statistically significant factors with high odds ratio (17.32 and 2.83, respectively) in both univariate and multivariate analyses. The peripancreatic fluid refers to acute peripancreatic fluid collection, which develops in IEP, while its counterpart is calledacute necrotic collection, which occurs in NP (2). An acute peripancreatic fluid collection contains amylase- and lipase-rich fluid and results from pancreatic or peripancreatic inflammation or from a rupture of pancreatic branch duct. Acute necrotic collection contains both liquefied and non-liquefied necrotic materials (4). Although the two collections are clearly separately defined in the revised Atlanta classification, differentiating the two in the early phase may not be easy on CT because both collections may be homogeneous and non-enhancing, which suggest fluid attenuation (18).

Heterogeneous enhancement of the pancreatic parenchyma was another imaging findings that could predict NP in our study. It is reported that early contrast-enhanced CT may underestimate the virtual extent of pancreatic and peripancreatic fat necrosis, presumably because the impairment of pancreatic perfusion and signs of peripancreatic necrosis evolve over several days (7, 19). In the early phase, pancreatic parenchyma on CT may be patchy and with variable attenuation before the hypo-perfused area becomes more distinctive or confluent (2). It is often confusing when low attenuation of the gland due to interstitial edema seen on IEP mimics the small region of parenchymal necrosis (17). In contrast, although pancreatic necrosis may initially appear homogeneous low attenuation, the necrotic area can become heterogeneous as necrotic tissue gradually liquefies (4).

Other than CT imaging findings, clinical and laboratory factors were assessed to predict NP in the early phase. Regarding the etiology of acute pancreatitis, the proportion of alcohol as the cause was significantly higher in the IEP-NP group (63.6%) than in the IEP-IEP group (53.2%) compared with biliary stone (12.1% and 26.8%, respectively). The reason for this result is should be explored more, but possible explanation is that patients with excessive alcohol consumption tend to have a more recurrent and chronic disease course compared to patients with other causes and may have more risks for progression to severe pancreatitis. Among laboratory factors, the serum C-reactive protein level and white blood cell count were statistically significant. C-reactive protein (12 mg/dL) was already used as a criterion for the early presence of pancreatic necrosis in a previous study (20), and another study suggested that C-reactive protein > 190 mg/dL at 48-hour predicted severe disease (21).

This study has several limitations. First, our study is prone to the criticism of CT radiation hazard and unnecessary early CT scans. Certainly, we value the cautions that clinicians should

be restrictive in the use of early CT in patients with acute pancreatitis, particularly in mild acute pancreatitis, to minimize radiation exposure and save costs (7). However, our point is that, we aimed to identify the useful imaging findings to predict NP in patients with mild acute pancreatitis or IEP who already underwent early CT for various reasons, particularly to search for the cause of acute pancreatitis. Second, inter-observer variability was not assessed in image analysis, which may have suffered from bias. However, images were reviewed by experienced radiologists with more than 10-year experience in abdominal radiology and the third review was also conducted for the discrepant cases. According to the international inter-observer study, the agreement was good for the type of acute pancreatitis and peripancreatic collections based on the revised Atlanta classification, which promoted widespread adaption of the classification (22).

In conclusion, the diagnosis of NP might not be sure in the early CT scan. The presence of peripancreatic fluid and heterogeneous enhancement of the pancreatic parenchyma at the initial contrast-enhanced CT may be helpful to predict the progression to NP in patients initially diagnosed with IEP.

Author Contributions

Conceptualization, P.H.S.; data curation, S.Y.S., P.H.S.; formal analysis, S.Y.S., P.H.S.; investigation, S.Y.S., P.H.S.; methodology, S.Y.S., P.H.S.; project administration, P.H.S.; supervision, P.H.S.; validation, P.H.S., Y.M.H.; writing—original draft, S.Y.S., P.H.S.; and writing—review & editing, P.H.S., Y.M.H., K.Y.J., J.S.I.

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

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J Korean Soc Radiol 2020;81(6):1436-1447

대한영상의학회지

개정된 아틀란타 분류법에 근거한 초기 CT에서의 괴사성 췌장염의 예측

송연선 · 박희선* · 유미혜 · 김영준 · 정성일

목적 간질부종성 췌장염으로 진단된 환자군에서 괴사성 췌장염으로의 진행을 예측할 수 있는 입원 당시 초기 임상소견 및 CT 소견을 알아보고자 한다.

대상과 방법 간질부종성 췌장염으로 진단되어 입원 당시 및 14일 이내 추적 조영증강 CT를 시행한 178명의 환자를 대상으로 하였다. 두 명의 영상의학 전문의가 추적 CT를 분석하여 간질부종성 또는 괴사성 췌장염을 결정하였다. 입원 당시 혈액검사 소견도 기록하였다. 간질부종성-간질부종성 췌장염 환자군과 간질부종성-괴사성 췌장염 환자군 간에 임상소견, CT 소견 및 혈액검사 소견들을 비교하였다. 다변량 분석도 시행하였다.

결과 간질부종성-간질부종성 췌장염 환자군은 112명, 간질부종성-괴사성 췌장염 환자군은 66명이었다. 알코올성 췌장염의 비율은 간질부종성-괴사성 췌장염 환자군이 더 높았다. 입원 당시 CT 소견 중 췌장주위 액체저류, 췌장실질의 비균질성은 간질부종성-괴사성 췌장염 환자군에서 더 흔하게 나타났다. 입원 당시 혈액검사 소견 중 혈청 C-반응성 단백 수치 및 백혈구수가 간질부종성-괴사성 췌장염 환자군에서 더 높게 나타났다. 다변량 분석을 시행했을 때 췌장주위 액체저류와 췌장실질의 비균질성 소견이 두 환자군을 구별하는데 유의한 인자로 나타났다.

결론 초기 CT상 간질부종성 췌장염으로 진단된 환자군에서 CT 소견 중 췌장주위 액체저류, 췌장실질의 비균질성은 괴사성 췌장염으로의 진행을 예측하는 데 도움이 된다.

건국대학교 의학전문대학원 영상의학교실