Appendix 1

S1 The classification of etiological factors and the definition of recurrent acute pancreatitis (AP)

S1.1 Classification of etiological factors

The etiology was divided into the following groups: (I) biliary, when gallstones were detected in the gallbladder or bile ducts in any image; (II) alcoholic, where 60 g or more alcohol was consumed per day for 5 years; (III) idiopathic, when no cause was found after a detailed examination; (IV) hypertriglyceridemia, when the level of fasting triglycerides was >1,000 mg/dL (11.3 mmol/L).

S1.2 Definition recurrent AP

Recurrent AP was defined as one or more recurrent AP episodes >3 months after the first AP in complete remission.

S2 Computed tomography (CT) image acquisition

All patients underwent contrast-enhanced computed tomography (CECT) upon abdominal imaging using one of the three following multidetector row CT systems: Aquilion ONE (Toshiba, Tokyo, Japan), Ingenuity CT (Philips Medical System), and Somatom Definition Flash (Siemens Healthineers). For the first two CT scanners, the main acquisition parameters were as follows: tube voltage of 120 kV (both), tube current of 250 mA (both), field of view (FOV) of 40×40 cm (both), matrix of 512×512 (both), collimation of 320×0.5 mm and auto, pitch of 0.87 and 1.015, and slice thickness of 5.0 mm (both). After a routine nonenhanced scan, arterial- and portal venous-phase CECT scans were performed after 25–30 and 48–50 s of delay following the intravenous administration of iodinated contrast material (Ultravist 370, Bayer Schering Pharma) at 1.5 mL/kg at a rate of 3 mL/s using a pump injector.

For Somatom Definition Flash, the main acquisition parameters were as follows: tube voltage of 100 kV, tube current of 318 mA, FOV of 33×33 cm, collimation of 128×0.6 mm, pitch of 0.8, and slice thickness of 5.0 mm. An automatic exposure control system (Care Dose 4D; Siemens Medical Solutions) was used when performing scanning. After a routine nonenhanced scan, arterial- and portal venous-phase CECT scans were performed after 25 and 40 s of delay following the intravenous administration of iodinated contrast material (Ultravist 370, Bayer Schering Pharma) at 1.5 mL/kg at a rate of 3.5–5 mL/s using a pump injector.

S3 Feature extraction

The details of extracted radiomics features are shown in *Figure S1*.

S.3.1 First-order statistics (N=19)

- Interquartile range;
- Skewness;
- Uniformity;
- Median;
- Energy;
- Robust mean absolute deviation;
- Mean absolute deviation;
- Total energy;
- Maximum;
- Root mean squared;
- 90^{th} percentile;
- Minimum;
- Entropy;
- Standard deviation;

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- Range;
- Variance;
- 10^{th} percentile;
- Kurtosis;
- Mean.

S3.2 High-order statistics (N=60)

Gray level cooccurrence matrix (N=28)

- Sum variance;
- Homogeneity 1;
- Homogeneity 2;
- Cluster shade;
- Maximum probability;
- Idmn;
- Sum variance 2;
- Contrast;
- Difference entropy;
- Inverse variance;
- Entropy;
- Dissimilarity;
- Difference variance;
- Idn;
- Idm;
- Correlation;
- Autocorrelation;
- Sum entropy;
- Average intensity;
- Energy;
- Sum squares;
- Cluster prominence;
- Sum average;
- Imc2;
- Imc1;
- Difference average;
- Id;
- Cluster tendency.

Gray level run length matrix (N=16)

- Short run low gray level emphasis;
- Gray level variance;
- Low gray level run emphasis;
- Gray level non-uniformity normalized;
- Run variance;
- Gray level non-uniformity;
- Long run emphasis;
- Short run high gray level emphasis;
- Run length non-uniformity;
- Short run emphasis;
- Long run high gray level emphasis;

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- Run percentage;
- Long run low gray level emphasis;
- Run entropy;
- High gray level run emphasis;
- Run length non-uniformity normalized.

Gray level size zone matrix (N=16)

- Gray level variance;
- Low intensity large area emphasis;
- High intensity small area emphasis;
- Small area emphasis;
- Large area emphasis;
- Zone variance;
- Size zone variability normalized;
- Low intensity small area emphasis;
- High intensity emphasis;
- Intensity variability normalized;
- Zone percentage;
- Low intensity emphasis;
- Size zone variability;
- Intensity variability;
- Zone entropy;
- High intensity large area emphasis.

S3.3 Shape-based features (N=14)

- Maximum 3D diameter;
- Compactness 2;
- Maximum 2D diameter slice;
- Sphericity;
- Compactness 1;
- Elongation;
- Surface volume ratio;
- Volume;
- Flatness;
- Spherical disproportion;
- Roundness;
- Surface area;
- Maximum 2D diameter column;
- Maximum 2D diameter row.

S4 Preprocessing methods for images and data

S4.1 Resampling

In our study, CT images were collected using three different scanners with variable acquisition techniques and parameters; thus, the radiomics were difficult to reproduce. To diminish the influence of the variable CT parameters, we used the resampling method to process the images before extracting features and resample the voxel resolution of all images to 1 mm × 1 mm × 1 mm.

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S4.2 Min–Max normalization

Different radiomics features have different value ranges, which makes it difficult to compare two features with variable orders of magnitude. Prior to further analysis, Min–Max normalization was used to normalize the maximum and minimum values in the data column, and the standardized value was between 0 and 1. The following formula was used:

$$X_{norm} = \frac{X - X_{min}}{X_{max} - X_{min}} \quad [1]$$

where X_{norm}, X, X_{min}, and X_{max} represent the normalized data, raw data, minimum value, and maximum value, respectively.

S5. Information of eleven selected radiomics features after dimensionality reduction and feature selection

S5.1 Radiomics features of arterial phase

- Squareroot_glszm_Size Zone Variability;
- Original_first order_Median;
- Original_first order_Total Energy;
- wavelet-LHH_glcm_Idmn;
- wavelet-HLL_first order_Median.

S5.2 Radiomics features of venous phase

- log-sigma-3-0-mm-3D_glcm_Imc2;
- log-sigma-3-0-mm-3D_glrlm_ Run Length Non-Uniformity;
- Squareroot_ first order_Skewness;
- Squareroot_glcm_Imc2;
- wavelet-LHL_glszm_Zone Entropy;
- wavelet-HLL_glszm_Zone Entropy.

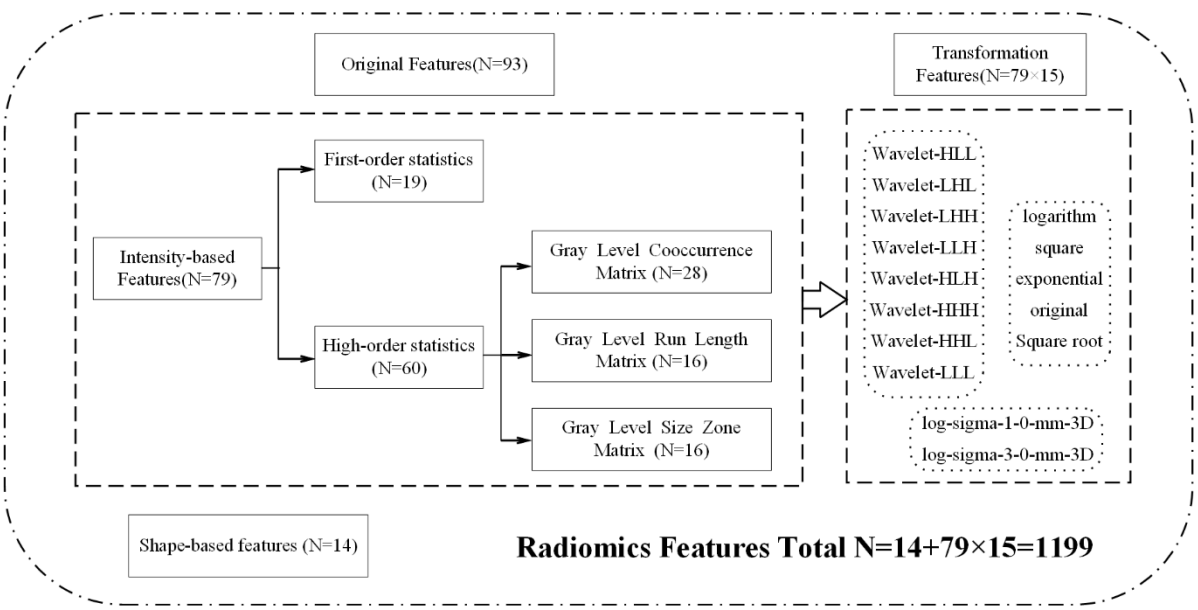

Figure S1 The details of extracted radiomics features.

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Table S1 The performance of the radiomics model, clinical model, and combined model in the training cohort, the internal validation cohort and the external validation cohort with the AdaBoost method

Model	Training cohort			Internal validation cohort			External validation cohort		
	Clinical	Radiomics	Combined	Clinical	Radiomics	Combined	Clinical	Radiomics	Combined
AUC (95% CI)	0.709 (0.622, 0.723)	0.902 (0.854, 0.923)	1.000 (0.914, 0.970)	0.603 (0.743, 0.91)	0.913 (0.844, 0.969)	0.869 (0.803, 0.956)	0.595 (0.585, 0.759)	0.837 (0.870, 0.985)	0.788 (0.852, 0.981)
Accuracy	0.741	0.911	1.000	0.679	0.839	0.696	0.670	0.766	0.702
Sensitivity	0.570 (49/86)	0.872 (75/86)	1.000 (86/86)	0.727 (16/22)	0.727 (16/22)	0.955 (21/22)	0.519 (14/27)	0.704 (19/27)	0.667 (18/27)
Specificity	0.848 (117/138)	0.935 (129/138)	1.000 (138/138)	0.647 (22/34)	0.912 (31/34)	0.529 (18/34)	0.731 (49/67)	0.791 (53/67)	0.716 (48/67)
PPV	0.700 (49/70)	0.893 (75/84)	1.000 (86/86)	0.571 (16/28)	0.842 (16/19)	0.568 (21/37)	0.438 (14/32)	0.576 (19/33)	0.486 (18/37)
NPV	0.760 (117/154)	0.921 (129/140)	1.000 (138/138)	0.786 (22/28)	0.838 (31/37)	0.947 (18/19)	0.790 (49/62)	0.869 (53/61)	0.842 (48/57)
F1-score	0.628	0.880	1.000	0.640	0.800	0.712	0.475	0.633	0.562

The brackets in the table show the numerator and denominator of the sensitivity, specificity, PPV and NPV. AUC, area under the receiver operating characteristic curve; CI, confidence interval; PPV, positive predictive value; NPV, negative predictive value.

Table S2 The performance of the radiomics model, clinical model, and combined model in the training cohort, the internal validation cohort and the external validation cohort with the Decision Tree method

Model	Training cohort			Internal validation cohort			External validation cohort		
	Clinical	Radiomics	Combined	Clinical	Radiomics	Combined	Clinical	Radiomics	Combined
AUC (95% CI)	0.5 (0.5, 0.696)	0.821 (0.757, 0.821)	0.813 (0.916, 0.970)	0.5 (0.5, 0.791)	0.766 (0.740, 0.896)	0.735 (0.803, 0.956)	0.5 (0.5, 0.629)	0.695 (0.695, 0.896)	0.688 (0.844, 0.981)
Accuracy	0.616	0.839	0.848	0.607	0.786	0.679	0.713	0.723	0.713
Sensitivity	0.000 (0/86)	0.756 (65/86)	0.663 (57/86)	0.000 (0/22)	0.636 (14/22)	1.000 (22/22)	0.000 (0/27)	0.630 (17/27)	0.630 (17/27)
Specificity	1.000 (138/138)	0.891 (123/138)	0.964 (133/138)	1.000 (34/34)	0.882 (30/34)	0.471 (16/34)	1.000 (67/67)	0.761 (51/67)	0.746 (50/67)
PPV	NaN (0/0)	0.813 (65/80)	0.919 (57/62)	NaN (0/0)	0.778 (14/18)	0.550 (22/40)	NaN (0/0)	0.515 (17/33)	0.500 (17/34)
NPV	0.616 (138/224)	0.854 (123/144)	0.821 (133/162)	0.607 (34/56)	0.789 (30/38)	1.000 (16/16)	0.713 (67/94)	0.836 (51/61)	0.833 (50/60)
F1-score	0.000	0.778	0.770	0.000	0.714	0.710	0.000	0.567	0.557

The brackets in the table show the numerator and denominator of the sensitivity, specificity, PPV and NPV. AUC, area under the receiver operating characteristic curve; CI, confidence interval; PPV, positive predictive value; NPV, negative predictive value; NaN, not a number, which represents an undefined value.

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