```
┌──────────────────────────────────────────────────────────────┐
│ Pathologically confirmed breast cancer by core needle biopsy │
│ or surgical resection  between January 2012 and December 2022 │
│                       n=1022                                  │
└──────────────────────────────────────────────────────────────┘
                              │
                              ▼
┌──────────────────────────────────────────────────────────────┐
│ Ultrasound examination performed before invasive procedures   │
│                       n=833                                    │
└──────────────────────────────────────────────────────────────┘
                              │
                              │          ┌──────────────────────────────────────────┐
                              │          │ Exclusion criteria (n=344)               │
                              │          │                                          │
                              │- - - - ->│ ▪ Received breast cancer treatment (n=24) │
                              │          │ ▪ HER2 status was equivocal (n=111)      │
                              │          │ ▪ Poor quality ultrasound images (n=32)  │
                              │          │ ▪ Underwent invasive biopsy(n=18)        │
                              │          │ ▪ Incomplete clinical data(n=159)        │
                              │          └──────────────────────────────────────────┘
                              ▼
┌──────────────────────────────────────────────────────────────┐
│              Include patients  (n=489)                        │
└──────────────────────────────────────────────────────────────┘
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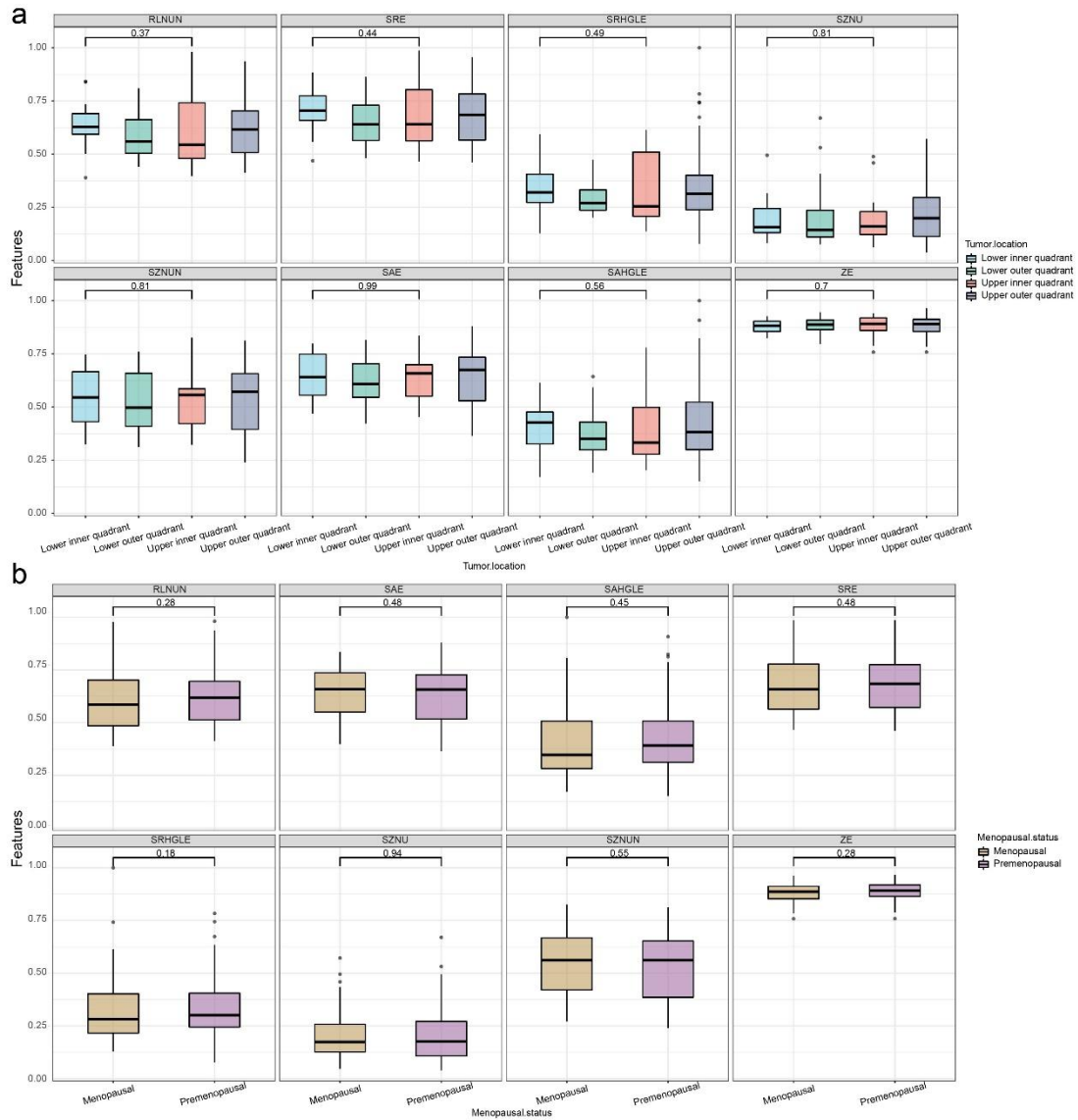
Fig. S1 Patient enrollment process of the study.

Fig. S2 The URFs data for subjects from the test set.

(**a**) shows four tumor location difference data for eight URFs and (**b**) shows menopausal status difference data. P-values for ANOVA are one-way analyses across sites or menopausal status for each phenotype.
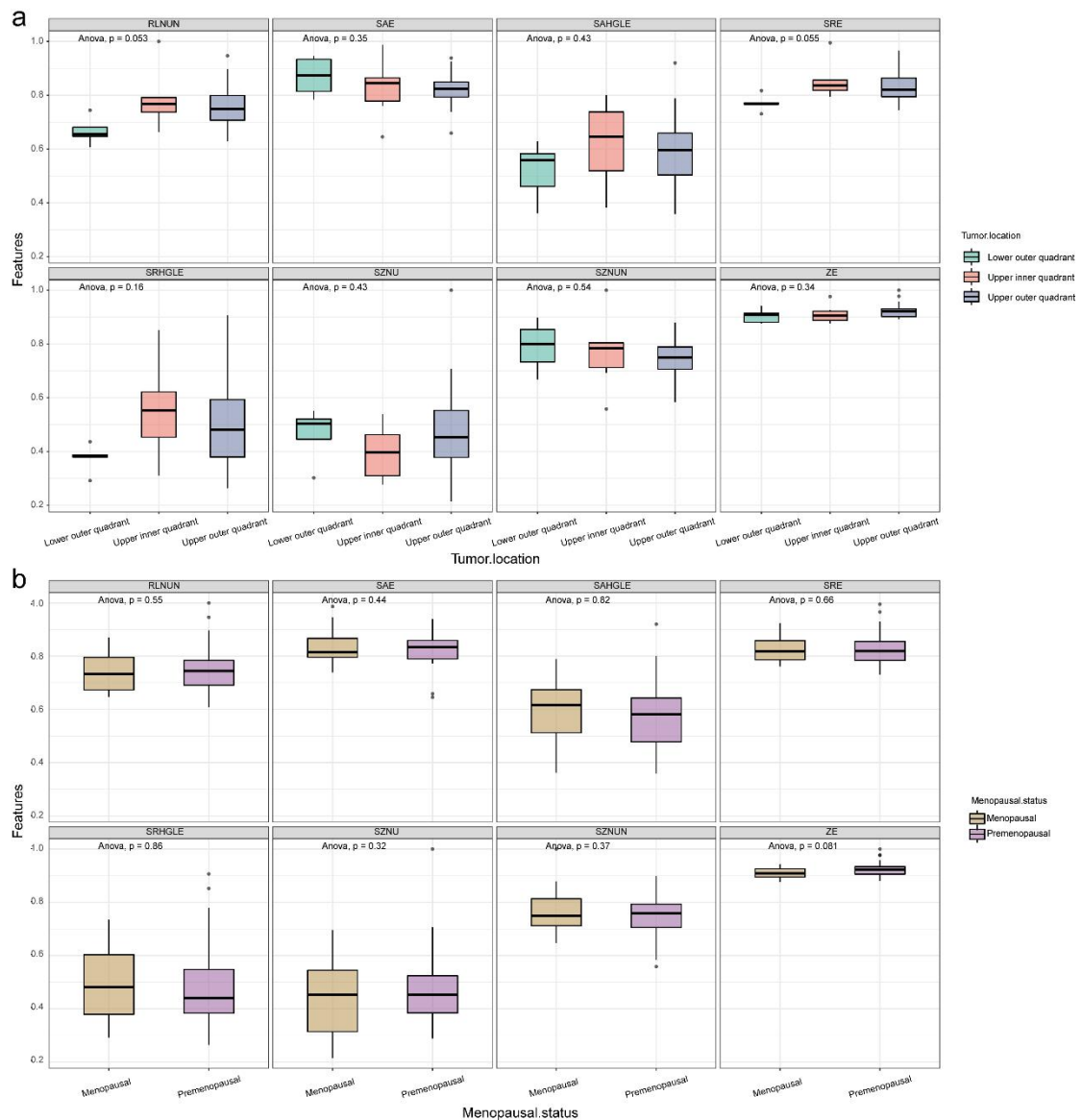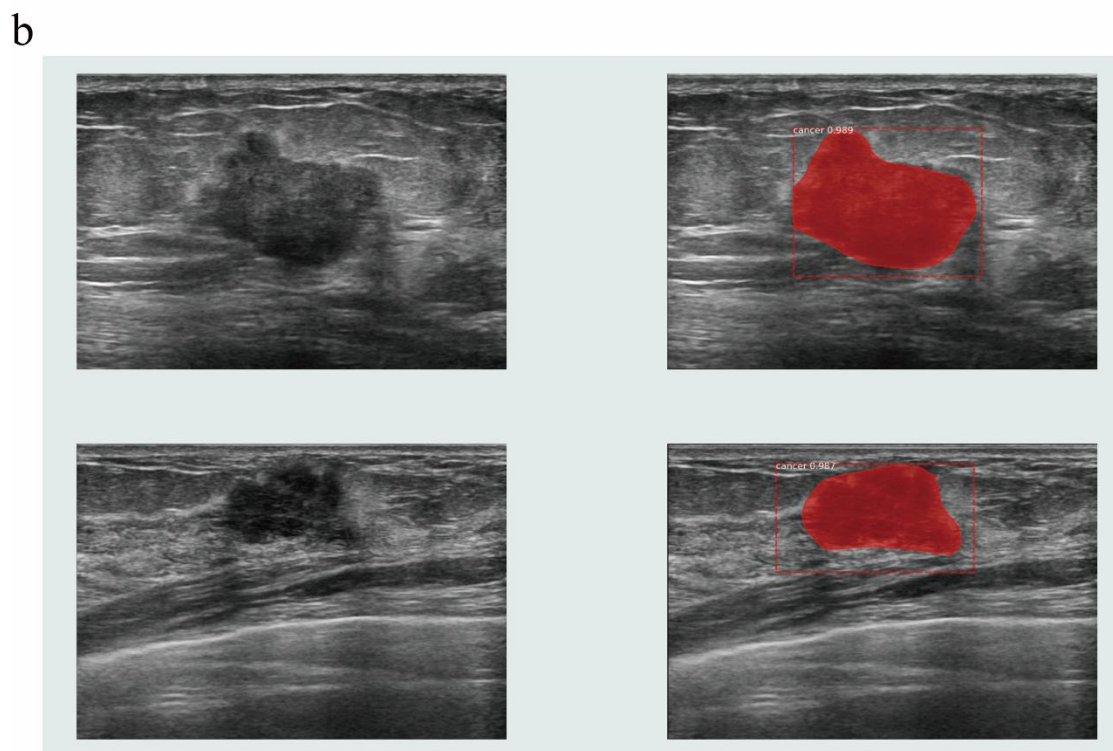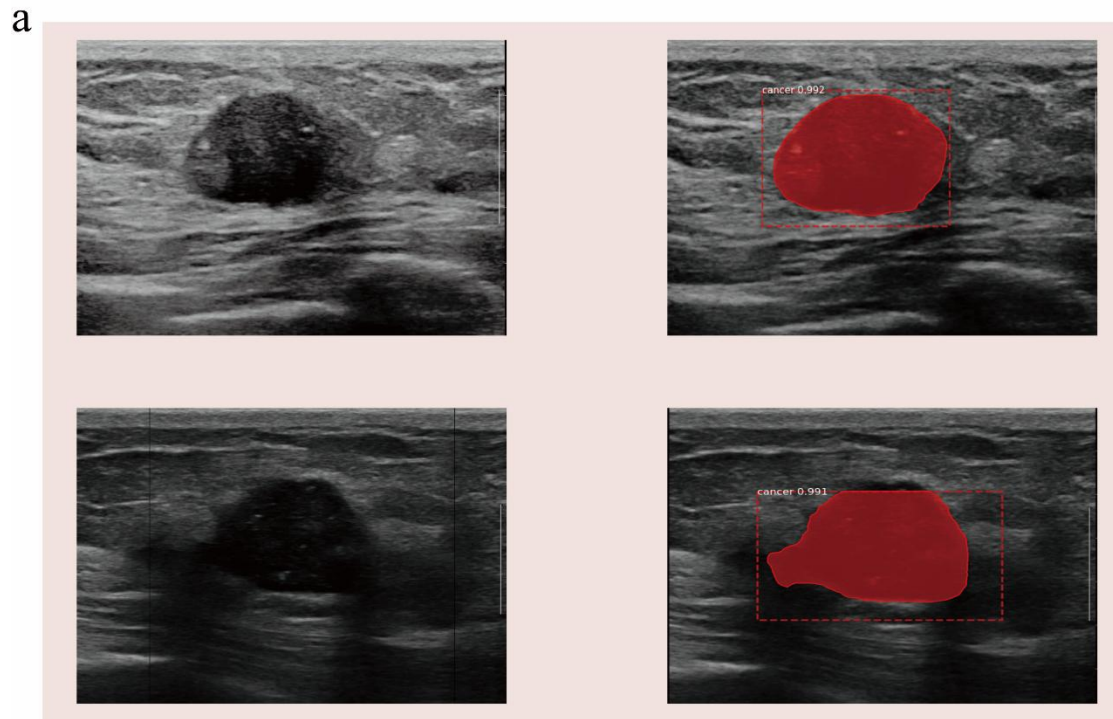
Fig. S3 The URFs data for subjects from the validation set.

(**a**) shows four tumor location difference data for eight URFs and (**b**) shows menopausal status difference data. P-values for ANOVA are one-way analyses across sites or menopausal status for each phenotype.

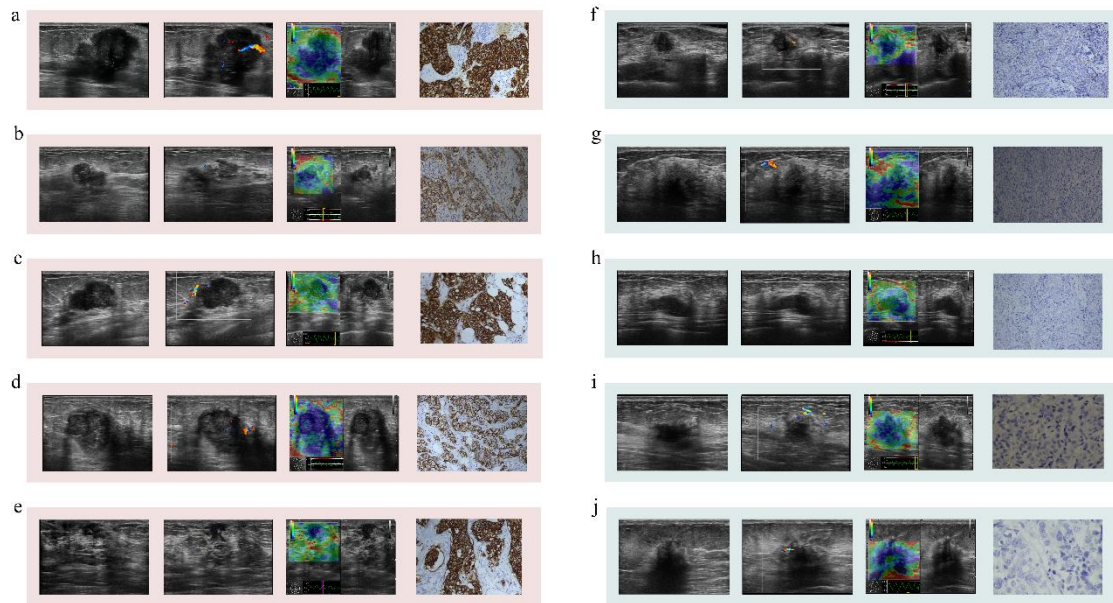Fig. S4 Recognition results of deep learning model for ultrasound.

Fig. S5 Examples of ultrasound and immunohistochemical images of 10 patients with breast cancer.

(**a-e**) Two-dimensional, color Doppler, elastic images and immunohistochemical images of 5 cases with HER2-positive. (**f-j**) Two-dimensional, color Doppler, elastic images and immunohistochemical images of 5 cases with HER2-negative.

Table S1: Predictive performance of logistic-based radiomics model for predicting the HER2 status in breast cancer.

	Radiomics test set		Independent validation set	
	URFs	URF-module	URFs	URF-module
AUC	0.712(0.620-0.817)	0.844(0.762-0.927)	0.556(0.427-0.665)	0.635(0.511-0.748)
ACC(%)	72.9(72.5-73.3)	80.2(79.9-80.5)	57.4(56.9-58.0)	66.0(65.5-66.4)
SPE(%)	74.5(63.0-86.1)	80.8(70.1-91.5)	64.8(52.1-77.6)	83.3(73.4-93.3)
PPV(%)	67.4(53.4-81.4)	77.8(65.6-89.9)	50.0(34.1-65.9)	65.4(47.1-83.7)
NPV(%)	77.4(66.1-88.6)	82.4(71.9-92.8)	62.5(49.8-75.2)	66.2(54.9-77.4)

Abbreviations: AUC, area under the receiver operating characteristic curve; ACC, accuracy; SPE, specificity; PPV, positive predictive value; NPV, negative predictive value; URFs, ultrasound radiomic features.