Supplementary Table 1 | Model Hyperparameter Optimization

Parameter	Range Tested	Optimal Value	Tuning Method	Performance Gain(%)
Learning rate	1e-3 - 1e-5	0.0001	Bayesian optimization	12.3
Batch size	16-256	64	Grid search	8.5
Attention heads	4-12	8	Ablation study	7.8
LSTM layers	1-3	2	Cross-validation	5.2
Dropout rate	0.1-0.5	0.3	Random search	4.7
Hidden units	64-512	256	Grid search	6.1
L2 regularization	1e-4 - 1e-2	0.001	Bayesian optimization	3.9

Supplementary Table 2 | Signal Quality Assessment Across BMI Categories

Signal Quality Metric	Low BMI (<25)	Normal BMI (25-30)	High BMI (>30)	P value
Signal-to-noise ratio, dB	28.3 ± 3.2	26.1 ± 3.8	23.4 ± 4.2	<0.001
Electrode contact score	0.95 ± 0.03	0.92 ± 0.04	0.88 ± 0.05	<0.001
Motion artifact index	0.12 ± 0.04	0.15 ± 0.05	0.19 ± 0.06	0.002
Data completeness, %	98.5 ± 1.2	97.2 ± 1.8	95.8 ± 2.1	0.008

Supplementary Table 3: Clinical Outcomes Associated with Pendelluft Detection

Clinical Outcome	Pendelluft Detected (n=45)	No Pendelluft (n=78)	P-value
Weaning time (days)	8.4 ± 2.7	5.1 ± 1.9	<0.001
ICU length of stay (days)	14.6 ± 3.8	9.2 ± 2.5	<0.001
Reintubation rate (%)	26.7 (12/45)	10.3 (8/78)	0.016
Ventilator-associated pneumonia (%)	24.4 (11/45)	9.0 (7/78)	0.018
Diaphragm thickness loss (%)	17.8 ± 4.3	8.6 ± 2.9	<0.001
Progression to ARDS (%)	22.2 (10/45)	7.7 (6/78)	0.020
Successful ventilator adjustment after pendelluft detection (%)	84.4 (38/45)	N/A	-
Hospital mortality (%)	15.6 (7/45)	7.7 (6/78)	0.167
30-day readmission (%)	20.0 (9/45)	11.5 (9/78)	0.189
Duration of mechanical ventilation (days)	10.2 ± 3.1	6.3 ± 2.2	<0.001

Values are presented as mean ± standard deviation or percentage (number of cases).

ARDS: Acute Respiratory Distress Syndrome; ICU: Intensive Care Unit

P-values <0.05 are considered statistically significant

Supplementary Table 4: Neural Network Architecture and Training Protocol Specifications

Component	Specifications
Model Architecture	
Input layer	Shape based on extracted features from CNN
Hidden layer 1	128 neurons, ReLU activation
Hidden layer 2	64 neurons, ReLU activation
Hidden layer 3	32 neurons, ReLU activation
Output layer	1 neuron, Sigmoid activation
Training Parameters	
Loss function	Binary cross-entropy
Optimizer	Adam
Learning rate	0.0001
Weight decay	0.00001
Batch size	32
Epochs	200
Early stopping	Patience = 20 epochs, monitor = validation loss
Data Augmentation	
Random rotation	±10°
Random zoom	±10%
Random horizontal flip	Probability = 0.5
Regularization	
Dropout rate	0.3 after each hidden layer
L2 regularization	Applied via weight decay
Cross-validation	

Validation method	5-fold cross-validation
Metrics	Accuracy, AUC, F1-score, Precision, Recall
Hardware	
GPU	NVIDIA RTX 3090 (24GB VRAM)
Framework	PyTorch 1.9.0
Hyperparameter Tuning	
Method	Grid search
Parameters tuned	Learning rate, weight decay, dropout rate, hidden layer sizes
Selection criterion	Average validation AUC across folds

Supplementary Table 5: Model Architecture and Training Protocol

Category	Parameter	Value
Neural Network Architecture		
	Input layer	EIT signal features (32 dimensions)
	Hidden layer 1	128 neurons, ReLU activation
	Hidden layer 2	64 neurons, ReLU activation
	Hidden layer 3	32 neurons, ReLU activation
	Output layer	1 neuron, Sigmoid activation
Training Protocol		
	Loss function	Binary cross-entropy
	Optimizer	Adam
	Learning rate	0.0001
	Weight decay	0.00001
	Batch size	32
	Epochs	200
	Early stopping	Patience=20, monitoring validation loss
	Data augmentation	Random rotation (±5°), scaling (±5%)
Hyperparameter Tuning		
	Cross-validation	5-fold
	Learning rate search	[0.01, 0.001, 0.0001, 0.00001]
	Regularization	L2 norm
	Dropout rate	0.3 (after each hidden layer)

	Batch normalization	Applied after first and second hidden layers
Model Implementation		
	Framework	PyTorch 1.10.0
	Hardware	NVIDIA A100 GPU
	Training time	~4.5 hours
	Model size	128 KB