pH of sentinel lymph nodes has correlation with their cancer involvement probability, A human model observational study in breast cancer patients

Supplementary Table 1. Specifications of various metastatic cancerous cells detection methods in the lymph node

Method [Ref.]	Mechanism	Gold Standard	Declared Accuracy	Detection time	# of Tested Samples
Microwave detection of metastasized breast cancer cells in the lymph node; potential application for sentinel lymphadenectomy [1]	Each specimen was placed in a specially designed sample holder and scanned using a broadband microwave vector network analyzer (VNA: HP8510C). In order to measure the permittivity of the area corresponding to the size of a hole, a probe was inserted into each hole of the sample holder until the probe tip was securely pressed against the sample surface. Then, using microwave waves (with a bandwidth of up to 30 GHz), cancerous cells in the lymph node were detected.	permanent H&E stained pathology, cytokeratin immunostaining	-	15–30 min after wave ablation	27 axillary LNs and seven pure cancer tissues were obtained from 12 patients diagnosed with invasive breast carcinoma
Electrical impedance scanning: a new technique in the diagnosis of lymph nodes in which malignancy is suspected on Ultrasound [2]	impedance imaging techniques	permanent H&E stained pathology	-	5–10 min	three ex vivo human prostates, ex vivo porcine
Real-time in vivo tissue characterization with diffuse reflectance spectroscopy during transthoracic lung biopsy: a clinical feasibility study [3]	diffuse reflectance spectroscopy (DRS)	permanent H&E stained pathology	-	real-time, biocompatible	ex vivo and in vivo tests of 6 patients
The correlation of in vivo and ex vivo tissue dielectric properties to validate electromagnetic breast imaging: initial clinical experience [4]	Electromagnetic (EM) breast imaging	permanent H&E stained pathology	-	low-cost, safe and potentially a more specific modality for cancer detection	ex vivo and in vivo tests of 21 patients

BGP	Electrochemical measurement of H_2O_2 release as a byproduct in hypoxia glycolysis reaction activated in tumor cells with CNT covered electrodes	permanent H&E stained pathology	95% sensitivity 93% accuracy	Additive ability of guiding the interventional radiologist to remove minimal number of samples under CNB, Evaluate the therapeutic effects on cancer tumors after chemo/radio therapies without complicated and expensive scanning, Simple handheld probe, Precise, real time and fast response	In vitro (cell lines) and In-vivo animal models with 4T1 and MC4L2 tumors

Supplementary Table 2. Basic information detailed of patients included in the study cohort

Patient ID	age	Cancer type	Biopsy Treatment	Grade	Node Size	Nodular states	Hormone status	Treatment
1	47	IDC	ALND	II	3.5cm	N1	ER+ PR+ HER2+	Adj
2	30	IDC	ALND	III	7cm	N1	ER+ PR+ HER2-	Adj
3	41	IDC	ALND	I	4cm	N1	ER+ PR+ HER2+	Adj
4	40	IDC	SLN	I	2cm	N0	ER+ PR+ HER2-	Adj
5	54	IDC	ALND	III	4cm	N1	ER+ PR+ HER2-	Adj
6	50	IDC	ALND	II	3cm	N2	ER+ PR+ HER2-	Neo
7	42	IDC	SLN	I	2cm	N0	ER+ PR+ HER2-	Adj
8	45	IDC	ALND	II	4cm	N1	ER- PR- HER2-	Adj
9	47	IDC	SLN	II	3cm	N0	ER+ PR+ HER2-	Adj

10	41	IDC	ALND	III	4cm	N2	ER+ PR+ HER2-	Neo
11	46	DCIS	SLN	I	7cm	N0	ER+ PR+ HER2-	Adj
12	27	IDC	ALND	III	4.5cm	N1	ER+ PR+ HER2-	Adj
13	60	IDC	ALND	II	2cm	N1	ER+ PR+ HER2+	Adj
14	62	IDC	SLN	I	1.5cm	N0	ER+ PR- HER2-	_
15	43	IDC	SLN	I	5cm	N0	ER+ PR+ HER2+	Adj
16	69	IDC	ALND	II	3cm	N1	ER- PR- HER2-	Adj
17	67	IDC	ALND	II	3.5cm	N2	ER+ PR+ HER2+	Neo
18	58	IDC	SLN	II	3.5cm	N0	ER+ PR+ HER2-	Adj
19	47	IDC	ALND	I	3.5cm	N1	ER+ PR+ HER2-	Adj
20	45	IDC	ALND	II	5cm	N2	ER+ PR+ HER2+	Neo
21	60	IDC+DCIS	SLN	II	1.3cm	N0	ER+ PR+ HER2+	Adj
22	40	60%IDC+invasive micropapillary carcinoma	SLN	II	1.2cm	N2	ER+ PR+ HER2-	Adj
23	39	IDC	ALND	III	1.4cm	N1	ER+ PR+ HER2-	Adj
24	47	IDC	SLN	I	0.8cm	N0	ER+ PR+ HER2-	Adj
25	36	IDC	ALND	II	0.7cm	N0	ER+ PR- HER2+	Neo
26	49	IDC	ALND	I	0.6cm	N0	ER+ PR+ HER2-	Adj
27	44	IDC	ALND	I	0.8cm	N2	ER+ PR+ HER2-	Adj

28	42	IDC	ALND	III	0.4cm	N0	ER+ PR+ HER2-	Neo
29	40	IDC	ALND	II	1.2cm	N3	ER+ PR+ HER2-	Adj
30	34	IDC	ALND	II	1cm	N2	ER+ PR+ HER2-	Adj
31	40	IDC	SLN	II	2cm	N0	ER+ PR+ HER2-	Adj
32	50	IDC+DCIS	SLN	II	1.5cm	N0	ER+ PR+ HER2-	Adj
33	44	IDC	ALND	II	1.5cm	N2	ER+ PR+ HER2-	Adj
34	37	IDC	ALND	II	1cm	N0	ER+ PR+ HER2+	Adj
35	30	IDC	SLN	I	1.5cm	N0	ER- PR- HER2-	Adj
36	31	IDC	ALND	II	5cm	N2	ER- PR- HER2-	Neo
37	35	IDC	SLN	II	5cm	N0	ER+ PR+ HER2-	Adj
38	40	IDC	SLN	I	2.5cm	N0	ER+ PR+ HER2-	Adj
39	30	IDC	SLN	II	2.5cm	N0	ER+ PR+ HER2-	Adj
40	52	IDC	SLN	I	1cm	N0	ER+ PR+ HER2-	Adj

Supplementary Table 3. Lymph node pH evaluations system scoring on lymph node samples vs. pathological diagnoses of 19 breast cancer patients. Positive samples indicated with Red (+), negative samples indicated with green (-). During this test two samples assumed as MLD false (Ten false positive and two false negative: patient's ID 1,2,5,10,14,21,25,38(sample ID 1,5,7,13,21,25,32,40,66,67) and 13, 30 (sample ID 24), 50). This test individually repeated by three needles and if even one of the needles showed acidic pH with pH lower than 7 (as experimentally was calibrated), then the LN would be declared as involved LNs.

Patient ID #	Patient samples #	Type of lymph node	Lymph node pH evaluations system diagnosis (pH value)	Permanent pathology diagnosis	Sensor response compare to Permanent pathology (gold standard)
1	1	Sentinel 1	7	-	FP
1	2	Sentinel 2	7	+	TP
2	3	Sentinel	6	+	TP
2	4	Auxiliary 1	6	+	TP

2	5	Auxiliary 2	6	-	FP
2	6	Auxiliary 3	6	+	TP
2	7	Auxiliary 4	6	-	FP
2	8	Auxiliary 5	6	+	TP
2	9	Auxiliary 6	6	+	TP
3	10	Sentinel 1	11	-	TN
3	11	Sentinel 2	8	-	TN
4	12	Sentinel	8	-	TN
5	13	Sentinel	6	-	FP
6	14	Sentinel 1	7	+	TP
6	15	Sentinel 2	6	+	TP
7	16	Sentinel	9	-	TN
8	17	Sentinel	8	-	TN
9	18	Sentinel 1	8	-	TN
9	19	Sentinel 2	8	-	TN
10	20	Sentinel 1	6	+	TP
10	21	Sentinel 2	7	-	FP
11	22	Sentinel	8	-	TN
12	23	Sentinel	7	+	TP
13	24	Sentinel	8	+	FN
14	25	Sentinel	7	-	FP
15	26	Sentinel	8	-	TN
16	27	Sentinel	6	+	TP
17	28	Sentinel	7	+	TP
18	29	Sentinel	6	+	TP
19	30	Sentinel	6	+	TP
20	31	Sentinel	8	-	TN
21	32	Sentinel 1	7	-	FP
21	33	Sentinel 2	7.5	-	TN
22	34	Sentinel 1	8	-	TN
22	35	Sentinel 2	7.5	-	TN
23	36	Auxiliary1	8	-	TN
23	37	Auxiliary2	8	-	TN
23	38	Auxiliary3	7.5	-	TN
24	39	Sentinel	8	-	TN
25	40	Auxiliary1	6	-	FP
25	41	Auxiliary2	8	-	TN
26	42	Auxiliary	9	-	TN
27	43	Auxiliary	8	-	TN
28	44	Auxiliary	9	-	TN
29	45	Auxiliary1	6	+	TP
29	46	Auxiliary2	6.5	+	TP
29	47	Auxiliary3	6	+	TP
30	48	Auxiliary1	7	+	TP
30	49	Auxiliary2	7.5	-	TN
30	50	Auxiliary3	7.5	+	FN
31	51	Sentinel	9	-	TN
32	52	Sentinel	10	-	TN
33	53	Auxiliary1	10	-	TN
33	54	Auxiliary2	7	+	TP
33	55	Auxiliary3	6.5	+	TP
34	56	Auxiliary	8	-	TN

35	57	Sentinel1	8	-	TN
35	58	Sentinel2	8	-	TN
35	59	Sentinel3	8	-	TN
36	60	Auxiliary ١	٥	+	TP
٣٦	٦١	Auxiliary ٢	٥	+	TP
٣٦	٦٢	Auxiliary ٣	٥	+	TP
٣٧	٦٣	Sentinel١	٨	-	TN
٣٧	٦٤	Sentinel٢	٨	-	TN
٣٧	٦٥	Sentinel٣	٨	-	TN
٣٨	٦٦	Sentinel١	٧	-	FP
٣٨	٦٧	Sentinel٢	٧	-	FP
٣٩	٦٨	Sentinel١	٨	-	TN
٣٩	٦٩	Sentinel٢	٨	-	TN
٣٩	٧٠	Sentinel٣	٨	-	TN
٤٠	٧١	Sentinel١	٩	-	TN
٤٠	٧٢	Sentinel٢	٩	-	TN
٤٠	٧٣	Sentinel٣	٩	-	TN
٤٠	٧٤	Sentinel٤	٩	-	TN