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Assessment of clinician accuracy for diagnosing melanoma on the basis of electrical impedance spectroscopy score plus morphology versus lesion morphology alone

To the Editor: Early detection and excision are important for optimizing melanoma patients' outcomes.[1] Making diagnoses on the basis of morphologic characteristics is challenging and can result in potentially unneeded biopsies or, worse, missed melanomas.[2] There is increasing interest in developing adjunctive tools that improve diagnostic accuracy.[3] Electrical impedance spectroscopy (EIS) has been shown to be highly sensitive in melanoma diagnosis.[4] The process of malignant transformation alters the electrical properties of cutaneous tissue—changes that are sensed by EIS. A low-voltage electrode is applied to the lesion; the resultant painless current propagates through the skin and is sensed by a receiving electrode on the same probe. The device generates a score of 0-10, corresponding to the different predictive values[4] for melanoma. Although an EIS device is Food and Drug Administration–approved and available (Nevisense, Scibase-AB, Stockholm, Sweden), little is known regarding how it affects clinicians' management of pigmented lesions. The goals of this study were to assess the impact of EIS results on clinicians' diagnostic accuracy and biopsy decisions.

In total, 164 dermatology trainees completed an online survey presenting clinical images of 45 pigmented lesions (28 benign, 17 melanoma). For each image, respondents were asked if they would recommend biopsy on the basis of morphologic assessment alone, and then asked again once presented with the corresponding EIS score (along with positive and negative predictive values[4]). The proportion of clinical decisions for which the addition of EIS score altered the decision to biopsy was calculated. In addition, the sensitivity, specificity, and proportion of missed melanomas and benign biopsies were determined for morphologic assessment alone and for morphologic assessment plus EIS score. Significance testing was performed using McNemar test for categorical variables and paired *t* tests for continuous variables.

Overall, 7380 clinical decisions (164 respondents × 45 lesions) were made on the basis of morphology alone and 7380 were made on the basis of morphology plus EIS score. The decision to biopsy was made in 4527 of 7380 cases on the basis of morphology alone and 4553 of 7380 cases on the basis of morphology plus EIS. The EIS results altered the individual biopsy decision in 24.3% of cases (Table I). The addition of the EIS score resulted in 402 fewer missed melanomas and a net decrease of 376 benign biopsies ($P < .001$, Table II). When including the EIS score, the mean sensitivity of respondents for ruling out melanoma increased from 80.7% to 95.2% ($P < .001$) and mean specificity from 50.4% to 58.6% ($P < .001$).

A diagnostic device is only useful if it affects clinical management and improves accuracy. In this

Table I. Change in clinical management (decision to biopsy) of pigmented lesions of 164 clinicians with the addition of electrical impedance spectroscopy score versus morphologic assessment of clinical image alone

Lesion type	No change in clinical management with EIS, n (%)	EIS results altered management from biopsy to observation, n (%)	EIS results altered management from observation to biopsy, n (%)	Overall change in decision to biopsy, n (%)
Benign, N* = 4592	3242 (70.6)	863 (18.8)	487 (10.6)	1350 (29.4)
Melanoma, N† = 2788	2350 (84.3)	18 (0.6)	420 (15.1)	438 (15.7)
Overall, N‡ = 7380	5592 (75.7)	881 (11.9)	917 (12.4)	1798 (24.3)

EIS, Electrical impedance spectroscopy.
*Total number of clinical decisions made on benign lesions (obtained by multiplying number of survey respondents, 164, by the number of benign lesions in the study, 28).
†Total number of clinical decisions made on malignant lesions (obtained by multiplying number of survey respondents, 164, by the number of malignant lesions in the study, 17).
‡Total number of clinical decisions made on benign and malignant lesions (obtained by multiplying number of survey respondents, 164, by the number of lesions included the study, 45).

Table II. Number of melanomas that would be missed and benign biopsies performed both clinically and with the addition of EIS results among 164 dermatology residents assessing 45 pigmented lesions

Melanoma lesion no.	EIS score	ABCD features present	Melanomas missed without EIS, n (%)	Melanomas missed with EIS, n (%)	Net change in melanomas missed with addition of EIS, n	*P* value*
4	7	ABC	2 (1.2)	0 (0)	−2	.50
5	6	AB	71 (43.3)	8 (4.9)	−63	<.001
8	9	ABCD	22 (13.4)	1 (0.6)	−21	<.001
10	4	AB	53 (32.3)	33 (20.1)	−20	<.001
14	8	ABCD	1 (0.6)	1 (0.6)	0	>.80
17	8	ABC	19 (11.6)	3 (1.8)	−16	<.001
19	6	CD	48 (29.3)	9 (5.5)	−39	<.001
22	4	ABC	3 (1.8)	6 (3.7)	+3	.375
26	7	ABCD	11 (6.7)	2 (1.2)	−9	.004
28	6	CD	75 (45.7)	15 (9.2)	−60	<.001
32	5	ABC	37 (22.6)	16 (9.8)	−21	<.001
33	10	ABC	9 (5.5)	2 (1.2)	−7	.039
37	9	ABCD	1 (0.6)	2 (1.2)	+1	>.80
39	8	BCD	28 (17.1)	2 (1.2)	−26	<.001
40	6	AC	109 (66.5)	23 (14.0)	−86	<.001
43	6	C	48 (29.3)	11 (6.7)	−37	<.001
44	6	ABCD	0 (0)	1 (0.6)	+1	>.80
Total			537 (19.3)	135 (4.8)	−402	<.001

Benign lesion no.	EIS score	ABCD features present	Benign biopsies performed without EIS, n (%)	Benign biopsies performed with EIS, n (%)	Net change in benign biopsies with addition of EIS, n	*P* value*
1	6	AC	46 (28.1)	142 (86.6)	+96	<.001
2	1	C	2 (1.2)	1 (0.6)	−1	>.80
3	4	CD	53 (32.3)	102 (62.2)	+49	<.001
6	5	C	29 (17.7)	111 (67.7)	+82	<.001
7	4	BCD	119 (72.6)	124 (75.6)	+5	.405
9	2	ABCD	81 (49.4)	14 (8.5)	−67	<.001
11	5	ABCD	150 (91.5)	161 (98.2)	+11	.001
12	3	CD	67 (40.8)	22 (13.4)	−45	<.001
13	4	BC	108 (65.8)	120 (73.2)	+12	.023
15	4	AB	97 (59.2)	116 (70.7)	+19	<.001
16	1	ACD	122 (74.4)	40 (24.4)	−82	<.001
18	2	ACD	138 (84.2)	61 (37.2)	−77	<.001
20	2	C	76 (46.3)	22 (13.4)	−54	<.001
21	3	C	34 (20.7)	9 (5.5)	−25	<.001
23	4	ABD	150 (91.5)	151 (92.1)	+1	>.80
24	2	A	65 (39.6)	10 (6.10)	−55	<.001
25	6	ABC	85 (51.8)	149 (90.9)	+64	<.001
27	4	ABC	128 (78.1)	131 (79.9)	+3	.648
29	2	AC	39 (23.8)	6 (3.7)	−33	<.001
30	1	BC	51 (31.1)	10 (6.1)	−41	<.001
31	1	AC	55 (33.5)	10 (6.1)	−45	<.001
34	0	AC	35 (21.3)	2 (1.2)	−33	<.001
35	5	AC	83 (50.6)	135 (82.3)	+52	<.001
36	1	ABC	125 (76.2)	46 (28.1)	−79	<.001
38	4	CD	32 (19.5)	75 (45.7)	+43	<.001
41	2	ACD	95 (57.9)	17 (10.4)	−78	<.001
42	0	ABCD	158 (96.3)	102 (62.2)	−56	<.001
45	2	ABCD	53 (32.3)	11 (6.7)	−42	<.001
Total			2276 (49.6)	1900 (41.4)	−376	<.001

A, Asymmetry; *B*, border irregularity; *C*, color variegation; *D*, diameter ≥ 6nn; *EIS*, electrical impedance spectroscopy.
*McNemar test.

study, EIS score led to a change in the decision to biopsy in ~25% of cases and improved diagnostic accuracy, resulting in fewer biopsies of benign lesions and more biopsies of melanomas, without significantly changing the total number of biopsies. A higher specificity was seen in this study compared with the EIS pivotal trial (58.6 vs 34.4%),[4,5] which measured the specificity of the device alone. This suggests that respondents utilized the EIS information synergistically with the clinical image, rather than basing decisions solely on the EIS results.

A limitation of this study was that additional clinical data, such as patient history, risk factors, and dermoscopic images, were not available to participants. In addition, as this study only included trainees, the results might not extrapolate to more experienced clinicians.

EIS had a meaningful impact on the decision to biopsy pigmented lesions with atypical features. When combined with morphologic assessment, EIS score led to improved accuracy without significantly changing the overall biopsy rate.

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