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Auricular Acupoints with Reduced Skin Resistance: Detection in Patients Scheduled for Hip Arthroplasty

Taras I. Usichenko, MD, PhD,[1,2,*] Bert Wetzel, Dipl Med,[1,*] James Paul, MD,[2]
Victor Lysenyuk, MD, PhD,[3] Klaus Hahnenkamp, MD, PhD,[1] and Johannes Fleckenstein, MD[4,5]

ABSTRACT

Objective: The detection of auricular acupuncture (AA) points by measuring electrical skin resistance (ESR) is often used in diagnostics and therapy; however, systematic investigations of ESR in AA points are rare. The aim of this study was to examine the frequency of detection of AA points with reduced ESR in patients scheduled for unilateral hip arthroplasty.

Materials and Methods: Data were obtained from 2 prospective clinical trials, which studied the perioperative analgesic effects of AA in patients with unilateral degenerative hip osteoarthritis. Three AA points (MA-TF1, MA-AH4, and MA-IC1) were examined in these patients before arthroplasty surgery using a SVESA (Neuralstift SVESA 1070, SVESA, Muenchen, Germany) neural pen. The frequency of AA points detection on the ipsi- and contralateral sides of the affected hip joint was registered and analyzed with a χ^2 test.

Results: The data of 114 patients (60 females) were available for analysis. AA points with lower ESR were detected more frequently on the side ipsilateral to the affected joint rather than on the contralateral side: 81% versus 37% of patients ($P < 0.0001$). None of the AA points could be identified at all in 13% of patients with diabetes mellitus versus 3% of patients without diabetes mellitus ($P = 0.07$).

Conclusions: AA points with low ESR were detected more frequently on the side ipsilateral to the underlying pathology. This finding is in agreement with neurophysiologic data. The therapeutic value of this finding should be clarified in future studies.

Keywords: auricular acupuncture, skin resistance, hip pain

INTRODUCTION

Auricular acupuncture (AA)—a microsystem of acupuncture initially described by French neurologist Paul Nogier, MD, in the 1950s[1]—has been attracting increased interest for diagnostic and therapeutic purposes in recent decades.[2–4] It is postulated that the external auricle contains a functional picture of the whole organism (a somatotopic view), whereas the pathology of the organs of human body lead to changes of specific areas on the external auricle. These changes can be identified as painful areas with decreased tissue density on palpation and reduced electrodermal resistance.

There is some evidence supporting the somatotopic theory of AA in patients with musculoskeletal disorders; the tender auricular points and the areas with increased skin conductivity corresponded with biomedical diagnoses in 75% of these cases in one study.[5] Another investigation

[1]Department of Anesthesiology, University of Medicine of Greifswald, Greifswald, Germany.
[2]Department of Anesthesia, McMaster University, Hamilton, Ontario, Canada.
[3]Department of Neurology and Rehabilitation Medicine, National Medical University, Kiev, Ukraine.
[4]Department of TCM/Acupuncture, Institute of Complementary Medicine, University of Bern, Bern, Switzerland.
[5]Department of Sports Medicine, Institute of Sports Sciences, Goethe-University of Frankfurt, Frankfurt, Germany.
*Both authors contributed equally to this work.

demonstrated reduced electrical skin resistance (ESR) on the auricle around specific Heart and Lung points in patients who had myocardial infarction or angina pectoris but not in patients without coronary artery disease.[6] Patients with liver dysfunction showed abnormalities on visual inspection in addition to reduced ESR of the auricular zones (that corresponded to the Liver acupoint according to the somatotopic maps, proposed by Dr. Paul Nogier[7]).

In order to enhance the potential analgesic effect of AA in randomized clinical trials (RCTs), [8,9] the current authors previously described a method of identifying AA points by detecting the areas with reduced ESR among patients scheduled for orthopedic surgery.[10] The results of the AA points' detection in 181 prospective patients were registered in the structured diagnostic protocol but had not been analyzed previously.

The aim of this investigation was to examine the frequency of successful detection of the auricular points with low ESR among patients with hip osteoarthritis (OA) who presented for unilateral hip arthroplasty (UHA) surgery.

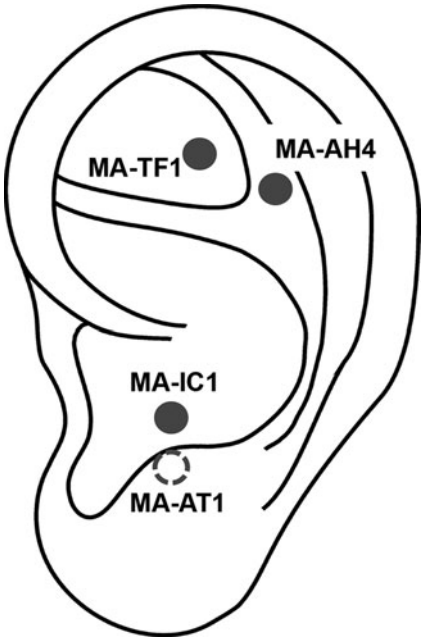

FIG. 1. Auricular acupuncture points, commonly used for perioperative analgesia, identified using measurement of electrical skin resistance. The MA-AT1 acupoint (Thalamus) is localized on the inner side of the antitragus (depicted with a dashed line).

MATERIALS AND METHODS

Design and Participants

This was a retrospective review of the study records from 181 patients, who underwent elective UHA and were included in 2 prospective clinical trials on the analgesic effects of AA.[8,9] These were patients with hip OA and American Society of Anesthesiologists (ASA) physical status of 1–3, who were scheduled for UHA because of degenerative OA. In these trials, the patients were not included if they had histories of continuous opioid consumption, alcohol use, psychiatric disease, morbid obesity (body mass index [BMI] $>40\,kg/m^2$), local or systemic infection, or cardiac valvular prosthesis or cardiac valvular disease. The local ethics commission at the University Medicine of Greifswald approved the protocols of both investigations and informed consent was obtained from all patients.[8,9]

Detection of AA Points

The patients from both investigations were treated according to the same protocol preoperatively and received AA for adjunctive analgesia on the evening before their surgery.[8,9] Before needling, each patient underwent systematic AA diagnostics, including inspection and detection of the AA points with reduced ESR. The choice of 3 AA points—MA-AH4 (Hip), MA-TF1 (*Shenmen*), and MA-IC1 (Lung)—for the intervention (Fig. 1) was based on principles and clinical reports described previously in detail.[5,8,10,11] The AA point MA-AT1 (Thalamus)—which was used for AA intervention only in one of both clinical trials,[8]—was not included as an AA point for treatment in the subsequent study of Wetzel et al.[9] and, therefore, was not included in the current analysis. The AA points are noted in this article according to AA nomenclature of the World Health Organisation[12] and then the French classification is noted in parentheses.[13]

The AA diagnostics, including ESR examination, were performed by 2 physicians, experienced in detection of AA points with this technique. After the visual inspection of the predefined auricular sites, where the above listed AA points are situated, the skin of these areas was examined using a SVESA neural pen (Neuralstift SVESA 1070, SVESA, Muenchen, Germany). This device is used for detection of skin zones with lower skin resistance, as described in detail elsewhere.[10] At the beginning of each examination, a reference zero-value of resistance was adjusted on the lateral margin of each ear lobe, which is free of acupuncture points. (The pressure applied on the examined AA zones with the tip of the neural pen should be kept constant during the examination of the same auricle.) Measuring time per AA zone was $\sim$10 seconds. For each patient, gender, weight, BMI, ASA classification, and medical history were recorded. The results of the examination were registered in a standardized diagnostic chart that was used to record the number of AAs detected on both the ipsilateral and contralateral ears to the site of the surgery.

Endpoints and Statistics

For each of three AA points, the number of spots with reduced ESR was calculated as frequency and % of the total number of AA points. A χ^2 test was applied to compare the

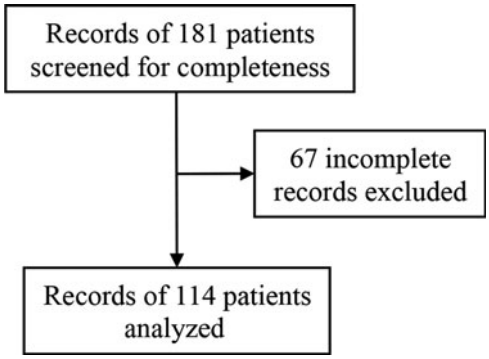

FIG. 2. Flowchart of retrospective review of the patients' records for the study.

distribution of AA points with reduced ESR on the ipsi- and contralateral sides of the affected hip joint. Statistical analysis was performed using SPSS, version 23, Chicago IL.

RESULTS

The records of 181 patients, included in 2 interventional AA trials, were screened for completeness (Fig. 2), The data of 114 patients (male/female ratio 61/53), ages 66 ± 10 years (mean ± standard deviation) were complete and were included in the final analysis. Patients' characteristics are given in Table 1.

In 5 patients, none of the AA points with reduced ESR was detected on either auricle. In 109 patients, at least 1 AA point with reduced ESR was detected, whereas MA-TF1 (*Shenmen*) was detected in 81%, MA-IC1 (Lung) was detected in 80%, and MA-AH4 (Hip) was detected in 77% of patients (Table 2; Fig. 3). AA points with reduced ESR were detected more frequently on the side ipsilateral to the affected joint rather than on the contralateral side (81% versus 33% of the patients [$P < 0.001$]).

Table 1. Patents' Characteristics (N = 114)

Characteristics	*Data*[a]
Age (years)	66 ± 10
BMI (kg/m^2)	29.9 ± 4.7
Body mass (kg)	85.1 ± 14.7
Gender (female/male)	61/53
ASA status	
1	9
2	49
3	56
Concomitant conditions	
Arterial hypertension	83
Diabetes mellitus	16
Obesity	60

[a]Data are given as mean ± standard deviation and number of patients
BMI, body mass index; ASA, American Society of Anesthesiologists.

Table 2. Frequency of Detection of Auricular Acupoints with Lower Skin Resistance in 114 Patients with OA Scheduled for Elective Unilateral Hip Arthroplasty

Auricular acupoints[a]	*Auricular acupoint according to surgery site*		*P-value*
	Ipsi	*Contra*	
Any acupoints detected	92 (81)	37 (33)	
MA-TF1 (*Shenmen*)	92 (81)	24 (21)	< 0.0001
MA-AH4 (Hip)	88 (77)	37 (33)	0.0002
MA-IC1 (Lung)	91 (80)	22 (19)	< 0.0001

[a]Auricular acupoints are noted according to the nomenclature of the World Health Organisation and then according to the French classification (in parentheses).
Data are given as number (%) and compared using a χ^2 test.
OA, osteoarthritis; ipsi, ipsilateral; contra, contralateral.

AA points could not be identified in 2 out 16 (13%) patients with diabetes mellitus, compared with 3 of 98 (3%) of patients who did not have diabetes mellitus ($P = 0.07$).

DISCUSSION

The analysis of the diagnostic data from 2 prospective randomized controlled trials on AA for complementary analgesia in patients with OA scheduled for elective UHA revealed that AA points with reduced ESR were detected in almost 80% of cases before surgery. AA points with reduced ESR were detected more frequently on the side ipsilateral to the affected joint rather than on the contralateral side; in patients with diabetes, AA points could not be identified at all more frequently than in patients without diabetes.

These findings are in agreement with the physiologic background of electrodermal changes on the external auricle. These electrodermal changes reflect the sudomotor activity of the skin, which is under control of the autonomic nervous system (ANS).[14] The AA points MA-AH4 (Hip), MA-TF1 (*Shenmen*), and MA-IC1 (Lung) are located in the concha and triangular fossa of the auricle, which receives a nerve supply through the cranial (trigeminal and vagal) nerves.[15] The afferent fibers of the auricular branch of the vagal nerve terminate in the ipsilateral solitary nucleus, which is involved in the transmission and processing of visceral nociceptive stimulation.[16,17] Thus, such painful areas with lower skin resistance appearing on the surface of the auricle might be the viscerocutaneous reflex projections of autonomic innervation of the auricle, similar to the Head zones of the body. This reflection could be conveyed through the ANS, in which pathways run always ipsilateral[18] in contrast to the somatosensory lateral

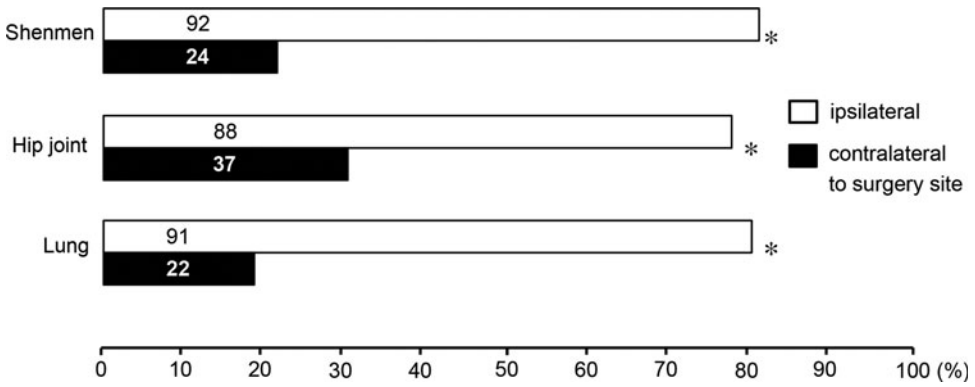

FIG. 3. Rate of frequency of auricular acupoint detection in patients with hip osteoarthritis before arthroplasty, using electrodermal measurements. Data are given as % of the total patients ($N = 114$); numeric values are absolute number of patients; $^*P < 0.001$, χ^2test.

spinothalamic tract. This tract is responsible for conducting information about temperature, pressure, and pain to the thalamus and cortex and crosses over to the contralateral side of the body at the level of the spinal cord.[19]

The finding that AA points with reduced ESR were not found in 13% of patients with diabetes mellitus versus 3% of patients without diabetes mellitus ($P = 0.07$) was statistically not significant, probably because of the insufficient sample size, given that the current authors had tried to avoid recruitment of patients with diabetes mellitus in the included AA therapeutic trials.[8,9] Nevertheless, it is known that even latent diabetic polyneuropathy influences the ANS so strongly that the measurement of electrodermal skin changes (sympathetic skin response) are recommended for early electrophysiologic diagnosis of this diabetes complication.[20,21] Thus, this finding supports the involvement of ANS in the phenomenon of electrodermal changes in AA points.

The results of the current investigation are in line with previous findings, which reported changes of electrodermal activity of the skin areas corresponding to AA points in patients with various underlying conditions. AA points with reduced ESR have been detected in 75%–80% of patients with musculoskeletal disorders,[5,10] and in more than 90% of patients with coronary heart disease and liver disease.[6,7] The majority of AA points with reduced ESR in these investigations was localized in the concha and cymba conchae as well as in the triangular fossa of the auricle (areas innervated by vagal and trigeminal nerves),[15] thus, confirming the potential mechanism of AA.[22]

Limitations of the current investigation included: (1) its retrospective design; (2) its subjective component during detection of AA points with lower ESR using the SVESA neural pen (although the method is simple and performed easily in a clinical setting, it provides reproducible data only in the hands of an experienced investigator); (3) the fact that the investigators who performed the detection of AA points were not blinded to the medical histories of the study patients. Nevertheless, these drawbacks might be reduced in a prospective investigation, using a computerized system for continuous multichannel measurement of ESR in healthy volunteers under painful challenges and in patients with painful disorders.[23]

CONCLUSIONS

Auricular acupuncture points with reduced ESR were detected more frequently on the side ipsilateral to painful joint in patients with unilateral hip OA. This finding is in agreement with neurophysiologic data. The therapeutic value of this finding can be clarified in future studies.

ACKNOWLEDGMENTS

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The initial interventional investigations were approved by the institutional ethics committee of the University of Medicine of Greifswald, Greifswald, Germany (reference numbers III UV 66/02 [8] and III UV 13/05 [9]) and were carried out in accordance with the principles of the Declaration of Helsinki.

AUTHOR DISCLOSURE STATEMENT

No competing financial conflicts exist.

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Address correspondence to:
Taras I. Usichenko, MD, PhD
Department of Anesthesiology
University Medicine of Greifswald
Sauerbruchstraße
17475 Greifswald
Germany

E-mail: taras@uni-greifswald.de