plexus (« the inverted fetus »). Furthermore, other clinical applications of auriculotherapy in neurology have been cited lately and provide an evidence-based medicine overview of this still little-known field of research[34].

Likewise, up and coming basic neuroscience research should also pay attention to the detection and stimulation of the ear area supplied by the superficial cervical plexus. Optogenetics manipulations may turn out to be the best option to validate the hypothesis of the auricular brain map in animal models. Indeed, optogenetics, a revolutionary research tool based upon bioengineered light-sensitive proteins, can optionally stimulate or silence particular cell types and neuronal circuits with milliseconds temporal accuracy[35-37]. Therefore, optogenetics might represent an alternative cutting edge approach in term of Auricular Neuromodulation both for the validation of the "ear hubs" corresponding to the brain hubs, potentially through transdermal ear illumination[38] and for unravelling the neural circuits involved in ear stimulation[39,40]. Finally, optogenetic manipulations may also contribute to optimize the ear stimulation parameters[41].

Optimizing ear stimulation parameters

Aside from defining the ear points, the optimal characteristics of the electrical stimulation have to be precisely determined. First, the frequency is of capital importance, otherwise , the stimulation even of the right ear point will not trigger any significant improvement[42,24]. Along these lines, the intensity of the optimal current, the wavelength and the duration of the ear stimulation each require scientific evaluation.

Once more, sharing the experience of ear acupuncturists should help neuroscientists. For instance, semi-permanent needles are inserted into the ear according to the electrical charge of the acupoint (thereby indicating whether the acupoint is active or not), which is a technique that gives a sense of the scale of the magnitude of the necessary stimulation to apply. Laser stimulation parameters, applied to the ears of neonates, could also help researchers get a headstart[43].

Conclusion

Auricular Neuromodulation is only in its early stages. So far, studies have concerned mainly tVNS. In view of the tremendous potential of the AN as an amazing concept, leading neuroscience research laboratories as well as other interested decision-makers should join in and show the way.

Conflict of interest statement

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Abbreviations

AN: Auricular Neuromodulation

SCP: Superficial Cervical Plexus

tDCS: transcranial Direct Current Stimulation

tES: transcranial Electrical Stimulation

TNS: Trigeminal Nerve Stimulation

tVNS: transcutaneous Vagus Nerve Stimulation

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