A New Approach to Objective Monitoring of Sympathetic Blocks for Chronic Pain Treatment through Infrared Thermal Imaging

Kronik Ağrı Tedavisinde Kullanılan Sempatik Blokların Objektif Monitörizasyonuna Kızılötesi Termal Görüntüleme ile Yeni Yaklaşım

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To the Editor;

In a recent article published at this journal, Ervural and Ceylan have discussed the use of artificial intelligence methods and thermal imaging in medical applications [1]. In their concluding statement, the authors of the article conjecture that infrared thermal imaging can potentially be used in the diagnosis and treatment of Complex Regional Pain Syndrome (CRPS).

Sympathetic blocks (SB) are used for both diagnosis and treatment of sympathetically mediated pain (SMP), including CRPS [2,3]. While successful SB can improve tissue perfusion, resulting in a reduction of edema and pain, these blocks may also have a high failure rate. In particular, while they are effective for sympathetically mediated pain, they are not effective in the treatment of sympathetically independent pain (SIP) [6].

Despite the frequent use of SB, monitoring and assessing the success of SB using conventional techniques is known to be difficult [3]. Commonly used methods for assessing the success of SB include observation of clinical signs, skin temperature monitoring, and pulse amplitude monitoring [4,5]. However, these methods often demonstrate unpredictable or delayed response. A monitor which can objectively, simply, rapidly, and accurately assess the success of SB would not only improve the diagnosis, but would also contribute to better patient care by increasing procedural accuracy and efficiency. In particular, an objective confirmation of sympathectomy created by an attempted SB could potentially help differentiate SMP from SIP and help better plan the prospective treatment options.

In a recent work, however, we have shown that comparison of pre- and post-operation thermal profiles of a limb can help objectively assess the success of the SB in clinical settings [7].

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Unfortunately, commercial infrared cameras are limited in their use in this context. Firstly, they provide point readings, while we need the temperature profile of the whole extremity. Moreover, the thermal images provided by the cameras include not only the limb, but also the background; therefore, a background elimination process has to be applied before a thermal profile can be created. Especially given the difficulty of collecting highly normalized thermal images in clinical settings, creating masks that separate the foreground (i.e. the feet) from the background is a nontrivial task that can benefit from artificial intelligence techniques.

Once the pre-and post-operation thermal profiles of the affected limb has been obtained, these can be compared using various methods. The simplest (and potentially easiest to interpret) approach would be to compare the average temperatures directly. Alternatively, temperature histograms can be created for both pre-and post-operation thermal profiles and these can be compared using histogram difference measures. A third alternative would be to create pre- and post-operation heatmaps and compare the spatio-thermal distributions of these heatmaps to pinpoint where the temperature difference is higher. These spatio-thermal patterns and their temporal evaluation after the operation can help better inform the clinician.

In conclusion, [7] has shown that infrared thermal imaging, coupled with image processing and analysis techniques, can be highly effective in assessing SB, addressing an urgent need in the treatment of CRPS patients.

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