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Thermal imaging monitoring of local temperature of isolated and transplanted liver and kidneys as a way to diagnose real time transplantation in the clinic

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Abstract

This paper describes a new method to monitor the quality of medical care during organ transplantation. The paper shows extreme temperature difference, demonstrates negative factors affecting the stability of the temperature regime of the transplant, and suggests a variant of intraoperative thermal imaging monitoring.

1 Introduction

One of the most important issues of transplantation is ischemic damage of allotransplanted organs. Ischemic damage of donor organs develops in conditions of cold ischemia and secondary thermal ischemia. Cold ischemia begins from the moment the vessels of the organs are washed with cooled storage solution and continues the entire period of cold preservation. Despite many years of research in the field of storing donor organs, the problem of temperature monitoring has not been solved, and to date, there is work to do in order to improve the storage solutions and methods of temperature monitoring. Secondary thermal ischemia begins with the extraction of the donor organ from the cooled storage solution and ends at the time when blood circulation restarts therein after applying vascular anastomoses. It was found that secondary thermal ischemia leads to increase of dystrophy and necrosis. It is possible to reduce the degree of these pathological changes by strictly observing the temperature regime of the storage solution.

2 Result and discussion

The existing world experience of thermometry in medicine [1-4] at the first stage of the study, let us evaluate the temperature of the storage solution and transplants at different stages of the operation. It was found that the median temperature of the transplant is +5.4 °C in the storage solution of the generally recognized worldwide temperature. Further we evaluated thermofluctuation of donor organs. When a transplant is removed from a cold solution, it is followed by natural heating, which

leads to the development of secondary thermal ischemia. On average, there is an increase in temperature +10,9 °C before the resumption of blood flow. The start of blood flow is in sync with normalization of the temperature in the donor organ and it depends on its size. However, reaching the normal temperature in the human body occurs differently and it can serve as a marker of the quality of donor organs. Among the negative factors that provoke secondary thermal ischemia, we can name the high ambient temperature, the work of electrocoagulators, the lack of means to cool organs outside the cold solution.

3. Conclusion

Thus, we found the temperature factors provoking complications of organ transplantation. We analyzed environmental factors and offered means to correct these factors on the basis of thermal imaging monitoring.

REFERENCES

[1] Ammer K.Temperature gradients in Raynaud´s phenomenon. Comparison by gender, age class and finger involvement. Thermology International.2010;20(3):100-109.

[2] Nick Rothbart, Christiane Maierhofer, Matthias Goldammer, Felix Hohlstein, Joachim Koch, Igor Kryukov, Guido Mahler, Bernhard Stotter, Günter Walle, Beate Oswald-Tranta & Martin Sengebusch (2017) Probability of detection analysis of round robin test results performed by flash thermography, Quantitative InfraRed Thermography Journal. 2016;14(1):1-23.

[3] Nicolas Lalanne, Jean-Claude Krapez, Christophe Le Niliot, Xavier Briottet, Jean Pierro & Luc Labarre (2015) Development and validation of a numerical tool for simulating the surface temperature field and the infrared radiance rendering in an urban scene, Quantitative InfraRed Thermography Journal. 2014;12(2):196-218.

[4] Urakova N.A., Urakov A.L. Diagnosis of intrauterine newborn brain hypoxia using thermal imaging video. Biomedical Engineering. 2014. V. 48. N 3. P. 111 – 115.