Rev Bras Anestesiol. 2016;xxx(xx):xxx–xxx

Sociedade Brasileira de Anestesiologia

REVISTA BRASILEIRA DE ANESTESIOLOGIA

Publicação Oficial da Sociedade Brasileira de Anestesiologia
www.sba.com.br

SCIENTIFIC ARTICLE

Infrared image monitoring of local anesthetic poisoning in rats☆

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Received 19 February 2015; accepted 22 April 2015

KEYWORDS
Monitoring;
Local anesthetics;
Acute intoxication;
Ropivacaine;
Infrared imaging;
Rats

Abstract
Background and objectives: To evaluate the thermographic predictive value of local anesthetic poisoning in rats that indicates the early recognition of thermal signs of intoxication and enable the immediate start of advanced life support.
Methods: Wistar rats underwent intraperitoneal injection of saline and ropivacaine; they were allocated into pairs, and experiments performed at baseline and experimental times. For thermography, central and peripheral compartment were analyzed, checking the maximum and average differences of temperatures between groups. Thermographic and clinical observations were performed for each experiment, and the times in which the signs of intoxication occurred were recorded. In the thermal analysis, the thermograms corresponding to the times of interest were sought and relevant data sheets extracted for statistical analysis.
Results: Basal and experimental: the display of the thermal images at times was possible. It was possible to calculate the heat transfer rate in all cases. At baseline it was possible to see the physiology of microcirculation, characterized by thermal distribution in the craniocaudal direction. It was possible to visualize the pathophysiological changes or thermal dysautonomias caused by intoxication before clinical signs occur, characterized by areas of hyper-radiation, translating autonomic nervous system pathophysiological disorders. In animals poisoned by ropivacaine, there was no statistically significant difference in heat transfer rate at the experimental time.
Conclusions: The maximum temperature, medium temperature, and heat transfer rate were different from the statistical point of view between groups at the experimental time, thus confirming the systemic thermographic predictive value.

☆ This article is part of Dr. Angelo Carstens' PhD thesis, Graduate Program in Clinical Surgery of the Federal University of Paraná, Curitiba, PR, Brazil.

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http://dx.doi.org/10.1016/j.bjane.2015.04.006
0104-0014/

PALAVRAS-CHAVE
Monitorização;
Anestésicos locais;
Intoxicação aguda;
Ropivacaína;
Imagem infravermelha;
Ratos

Monitorização por imagem infravermelha da intoxicação por anestésico local em ratos

Resumo
Justificativa e objetivos: Estudar o valor preditivo termográfico na intoxicação por anestésico local em ratos que efetue o reconhecimento precoce dos sinais térmicos de intoxicação e possibilite o início imediato do suporte avançado de vida.
Método: Ratos Wistar foram submetidos à injeção intraperitoneal de soro fisiológico e ropivacaína, alocados aos pares, e foram feitos experimentos em tempos basal e experimental. Para o estudo termodinâmico foram analisados o compartimento central e o periférico, verificaram-se as diferenças das temperaturas máximas e médias entre os grupos. Foram feitas observações clínicas e termográficas para cada experimento e anotados os tempos em que os sinais de intoxicação ocorriam. Foram buscados na análise termográfica os termogramas correspondentes aos tempos de interesse e extraídas as planilhas de dados correspondentes, para análise estatística.
Resultados: Foi possível a visibilização das imagens térmicas nos momentos basal e experimental. Foi possível calcular a taxa de transferência de calor em todos os casos. No momento basal foi possível observar a fisiologia da microcirculação, caracterizada por distribuição térmica no sentido craniocaudal. Foi possível visibilizar as alterações fisiopatológicas ou disautonomias térmicas causadas pela intoxicação antes que os sinais clínicos ocorressem, caracterizadas por áreas de hiperradiação e traduziram perturbações fisiopatológicas do Sistema Nervoso Autônomo. Nos animais intoxicados por ropivacaína houve diferença estatisticamente significativa na taxa de transferência de calor no momento experimental.
Conclusões: Constatou-se que a temperatura máxima, a temperatura média e a taxa de transferência de calor foram diferentes do ponto de vista estatístico entre os grupos no momento experimental, o que corrobora o valor preditivo termográfico sistêmico.

Introduction

Assessment of the systemic thermographic predictive value is very important for increasing safety in anesthesia and surgical procedures. The observation of accidents in clinical practice of anesthesia and their potentially fatal effects suggest the development of a supplementary perioperative monitoring method to predict cases of intoxication by local anesthetics (LA). This method can provide early recognition of the intoxication signs and the immediate start of advanced life support in these critical situations.

The direct intraperitoneal LA instillation started to be used in clinical practice, with confirmed efficiency and decreased morphine use for postoperative (PO) analgesia.[1] An important study in the UK showed results of decreased immediate postoperative pain complaints, particularly in the first hours and when LA was used intraperitoneal at the beginning of surgery. The study concluded that LA use is safe and provides significant pain reduction in the early postoperative period.[2] Another study of intraperitoneal LA nebulization for pain management was performed. The authors highlighted the importance of this technique, but stressed the need for further studies to evaluate the safety of intraperitoneal anesthetic administration.[3] This important observation demonstrates the relevance of the present study regarding the pathophysiology of acute intoxication induced by intraperitoneal LA.

Studies of intraperitoneal LA for PO analgesia in laparoscopic procedures have yielded conflicting results. LA distribution and inadequate absorption along the peritoneal surface were considered as one of the factors contributing to such results.[4–6] New forms of intraperitoneal LA administration were tested to provide analgesia and better distribution and peritoneal absorption, such as intraperitoneal aerosolization.[7] The development of new devices that deliver LA combine with the pneumoperitoneum insufflation gas is also highlighted.[8]

Bupivacaine has often been used in anesthesia, particularly in long procedures, and provides excellent sensory and motor anesthesia. However, some unexpected accidents with its use encouraged the search for safer options regarding cardiovascular complications, as well as central nervous system toxicity.[9] Because of these complications, ropivacaine was developed.[10] However, more studies are need to assess the behavior of thermal changes and the pathophysiology involved in its intraperitoneal administration and clinical implications.

Assessing the systemic thermographic predictive value in LA acute intoxication is of paramount importance to improve surgical safety, as neurotoxic and cardiotoxic complications are related to changes in microcirculation and vasomotor state and increased rate of intercompartmental heat transfer.

Therefore, it becomes scientific imperative the proposition of an experimental model consisting of a qualitative and quantitative predictive method for early recognition of poisoning signs and symptoms, understanding the involved pathophysiology, in order to improve the advanced life

Please cite this article in press as: Carstens AM, et al. Infrared image monitoring of local anesthetic poisoning in rats. Rev Bras Anestesiol. 2016. http://dx.doi.org/10.1016/j.bjane.2015.04.006