

Considerations about experimental model of intracranial hypertension and evaluation of the microchip system for monitoring of epidural pressure

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Introduction

There are well established method for the measurement with continuous monitoring and treatment of elevated ICP. The method of parenchymal or ventricular monitoring are the most reliable, but they has a higher risk of bleeding and infectious complications. Objectives: In this paper we aim to describe a new experimental animal model of intracranial hypertension and to evaluate the accuracy of the measurement with microchip epidural system

Methods

27 pigs with approximately 20 kg were studied, under general anesthesia, properly assisted with ventilation and hemodynamic monitoring. During the experiment, we have simulated frontal intracerebral hematoma. We use a multisensor intraparenchymal catheter and a epidural catheter. The experiment consisted of three groups (A, B and C) with intracranial hypertension generated with the simulation of an intracerebral hematoma. In all groups the normal

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Mediana	3,8	10,6	6,8	13,5	6,8	6,4	5	42,2	26,1	29,9	6.7	13,7	8,5	29,4	24,1	23,7	4,6	9.4
Ы	5,0	8,7	8,3	8,4	4,7	5,4	5,8	25,5	20,1	18,7	4,2	15,4	5,5	26,0	23,1	28,8	3,7	8,6
Média	4,2	15,0	11,8	13,3	6,1	6,2	6,6	36,1	31,6	31,0	6,7	15,0	8,9	32,0	27.4	31,7	5,5	12.2
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Results

The behavior of the ICP over the time points are statistically different between groups (p < 0.001). The simulation ressangramenta resulted in a significant increase in ICP (p < 0.001). Evaluating the overall comparative accuracy there was an intraclass correlation coefficient of 0.8. Using an evaluation of correlation between systems after balloon deflation by means of an analysis of the pressure curve measured by the two methods was observed a failure of correlations. However when evaluated differences in mean pressure at each time of the experiment, we identified a similarity between the systems of monitoring parenchymal and epidural

Figure 1: Image of the experiment, highlighting the parenchymal and epidural catheters and the balloon implanted in the brain





Conclusions

The model of intracranial hypertension balloon in pigs is feasible and reliable in generating intracranial hypertension. The system for measuring intracranial epidural pressure has a high correlation coefficient with the system parenchymal gauging the overall evaluation.

 Table 2: Description of

 measurements of intracranial

 pressure in all groups and time

 points and the results of

 correlation calculations.

variavei	wedia	UP	P20	Mediana	P/3	N	CUI	Inverior	Superio
PICp	7,83	6,27	3,5	5,2	11,3	9	0.660	-0,079	0,878
PICe	6,12	4,65	0,8	6,8	10,1	9	0,559		
PICp	4,97	3,85	2,4	4,8	7,9	9	0.000	-0,706	0,601
PICe	6,66	4,19	3,4	6,7	9,3	9	0,000		
PICp	5,14	5,86	0,7	2,2	10,7	9	0.000	-1,030	0,336
PICe	5,47	3,69	2,9	4,6	8,5	9	0,000		
PICp	20,97	19,27	6,7	14,6	31,6	207	0.000	0,745	0,844
PICe	19,76	20,59	5,8	12,2	25,5	207	0,000		
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Learning Objectives

1. To define accuracy of epidural intracranial pressure monitoring system

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2. To learn about animal model of intracranial pressure

3. To learn about efficacy of clinical and surgical treatment for intracranial hypertension and hemodynamics changes in acute phase of cerebral hematomas

References

1. Poca MA, Martínez-Ricarte F, Sahuquillo J, Lastra R, Torné R, Armengol MS. Intracranial pressure monitoring with the Neurodur-P epidural sensor: a prospective study in patients with adult hydrocephalus or idiopathic intracranial hypertension. J Neurosurg. 2008; 108(5):934-42.

2. Poca MA, Sahuquillo J, Topczewski T, Peñarrubia MJ, Muns A. Is intracranial pressure monitoring in the epidural space reliable? Fact and fiction. J Neurosurg. 2007; 106(4):548 -56.

3. Raabe A, Totzauer R, Meyer O, Stöckel R, Hohrein D, Schöche J. Reliability of epidural pressure measurement in clinical practice: behavior of three modern sensors during simultaneous ipsilateral intraventricular or intraparenchymal pressure measurement. Neurosurgery. 1998; 43(2):306-11.