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

Wellingson S. Paiva MD PhD; Almir F. Andrade MD, PhD; Alessandro Belon BA; Matheus S Soares MD; Marcelo Lima MD; Iuri S Neville MD; Leonardo Moura Sousa Jr MD; Clarissa G Nascimento MD; Jose P Otoch MD; Edson Bor-Seng-Shu MD, PhD; Manoel Jacobsen Teixeira

CNS 2014 Annual Meeting Boston Massachusetts

MEDICINA USP

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

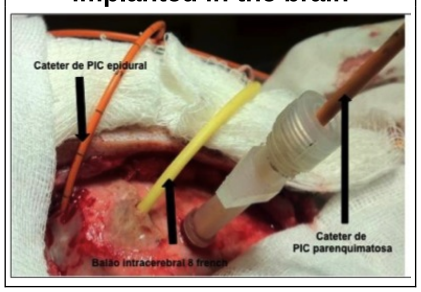
Table 1: Description of intracranial pressure measurement in the epidural system group and time points and the results of comparison testing

Grupo	Momento	Média	DP	Mediana	Mínimo	Máximo	N	P Grupo	P Momento	P Interação
A	Basal	4,2	5,0	3,8	0	16	9			
	Pré salina	15,0	8,7	10,6	4	27	9			
	Pós salina	11,8	8,3	6,8	4	25	9			
	Pré cirurgia	13,3	8,4	13,5	4	24	9			
	Pós cirurgia	6,1	4,7	6,8	0	12	9			
	Final	6,2	5,4	6,4	0	17	9			
B	Basal	6,6	5,8	5	0	16	9			
	Pré salina	36,1	25,5	42,2	4	70	9			
	Pós salina	31,6	20,1	26,1	5	63	9	0,067	<0,001	0,001
	Pré cirurgia	31,0	18,7	29,9	5	57	9			
	Pós cirurgia	6,7	4,2	6,7	0	14	9			
	Final	15,0	15,4	13,7	0	53	9			
C	Basal	8,9	5,5	8,5	4	20	9			
	Pré salina	32,0	26,0	29,4	5	87	9			
	Pós salina	27,4	23,1	24,1	7	84	9			
	Pré cirurgia	31,7	28,8	23,7	5	99	9			
	Pós cirurgia	5,5	3,7	4,6	1	12	9			
	Final	12,2	8,6	9,4	4	25	9			

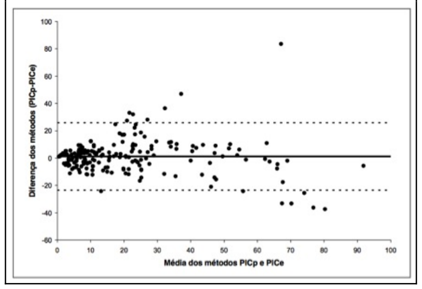
Results

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



Graph 1: Distribution of Bland-Altman method of the epidural and parenchymal measurements



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.

Grupo/ Momento	Variável	Média	DP	P25	Mediana	P75	N	CCI	IC 95% Inverior	IC 95% Superior
Grupo A pós cirurgia	PICp	7,83	6,27	3,5	5,2	11,3	9	0,559	-0,079	0,878
	PICe	6,12	4,65	0,8	6,8	10,1	9			
Grupo B pós cirurgia	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			
Grupo C pós cirurgia	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			
Todos	PICp	20,97	19,27	6,7	14,6	31,6	207	0,800	0,745	0,844
	PICe	19,76	20,59	5,8	12,2	25,5	207			

Learning Objectives

1. To define accuracy of epidural intracranial pressure monitoring system

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.