



A survey of routine treatment of patients with intracranial hypertension (ICH) in specialized trauma centers in Sao Paulo, Brazil: A 11 million metropole!



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ABSTRACT

Objective: A survey of intensive care units (ICU) in São Paulo that care for patients with TBI and ICH using the hyperventilation technique.

Methods: A questionnaire was given to the physiotherapist coordinator at 57 hospitals in São Paulo, where 24-h neurosurgery service is provided.

Results: Fifty-one (89.5%) hospitals replied. From this total, thirty-four (66.7% perform the hyperventilation technique, 30 (85%) had the objective to reach values below 35 mmHg, four (11%) levels between 35 mmHg and 40 mmHg and one (3%) values over 40 mmHg.

Conclusions: We concluded that most hospitals in São Paulo perform hyperventilation in patients with severe brain trauma although there are not any specific Brazilian guidelines on this topic. Widespread controversy on the use of the hyperventilation technique in patients with severe brain trauma highlights the need for a specific Global policy on this topic.

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1. Introduction

Intracranial hypertension (ICH) is the most critical and potentially devastating complication and most serious concern in patients with brain injury. Usually ICH is defined as an increase in the intracranial pressure (ICP) that occurs when there is an increase in any cerebral component volume, which exceeds the capacity of blood flow cerebral autoregulation [1]. The treatment protocol for ICH has two focused objectives: one focuses on the reduction of ICP including therapies such as controlled mechanical ventilation, administration of hyperosmotic solutions, and barbiturates; the other is focused on the maintenance of normal cerebral blood flow and cerebral perfusion pressure including the hyperventilation technique [2].

Hyperventilation can cause a rapid decline in ICP due to cerebral vasoconstriction where the vessels are still reacting to changes in partial carbon dioxide arterial pressure (PaCO₂) [3–5]. However,

the vasoconstriction effect on the brain arterioles caused by hyperventilation lasts from 11 to 20 h and after this time a rebound vasodilatation effect occurs due to local lactacidosis and hypoxia leading to an increase in cerebral blood flow and deterioration in ICH [6,7].

The third edition of the Guidelines for the Management of Severe Traumatic Brain Injury (TBI) (2007) does not recommend the use of hyperventilation due to insufficient evidence for its use. According to these Guidelines, independent of hyperventilation, cerebral blood flow can drop dangerously low in the first hours following severe TBI and the introduction of hyperventilation could further decrease cerebral blood flow, contributing to the likelihood of ischemia [8].

However this strategy is still used in Europe to treat patients with severe TBI. A retrospective study conducted in 22 centers in Europe concluded that hyperventilation is used extensively, intentionally or otherwise, in the treatment of severe TBI. While the overall adherence to the third edition of the Guidelines for the Management of Severe TBI seems to be the rule, their recommendations on early prophylactic hyperventilation (PaCO₂ < 35 mmHg) and additional cerebral oxygenation monitoring during forced hyperventilation are not followed in the majority of European TBI centers [9]. According to this study, there is evident controversy on the

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matter of hyperventilation between the American Guidelines and European countries.

A Brazilian Guidelines on Severe TBI does not exist but there is a recommendation to avoid using hyperventilation in these patients. It is not known how these patients are currently being treated in Brazil. São Paulo is a vast metropolis with approximately 11 million inhabitants, thus a high incidence of trauma and a large number of specialized hospitals on TBI. A survey in the local ICU on the use of hyperventilation technique in severe TBI may give us an idea if these hospitals are following the American or European recommendations.

Thus, the objective of this study was to survey the intensive care units (ICU) in São Paulo that provide care to patients with TBI and ICH on the use of the hyperventilation technique.

2. Methods

2.1. Sample selection

A list of all hospitals in São Paulo with an ICU was obtained from the City Health Registry and from the web site of the National Registry of Health Facilities (cnes.datasus.gov.br). Hospitals were contacted by telephone in order to check if they would meet the inclusion criteria.

2.2. Questionnaire

Initially three professionals with expertise in neurological intensive care designed a questionnaire on the utilization of hyperventilation in patients with ICH. The questionnaire was then evaluated by five physiotherapists working in ICU's with neurosurgical services in order to evaluate its understanding and relevance. The physiotherapists' suggestions helped to establish the final version of the questionnaire (Fig. 1). The questionnaire was sent to 57 hospitals that met the inclusion criteria: ICU in the hospital with a neurosurgical service, 24 h physiotherapist coverage, with a physiotherapist in charge of the physiotherapist group with a minimum of one year experience in intensive care. A hospital was excluded after it failed to answer our queries. The period of data collection was from January 2010 to July 2010. The questionnaire was answered by the physiotherapist in charge of the ICU.

This study protocol and the consent form were approved by Ethics Committee of the Federal University of São Paulo.

Numerical variables were expressed as mean \pm standard deviation for homogeneous data and as median and percentile in the case of heterogeneous data. Categorical variables were described as frequencies and percentages.

3. Results

Among the 186 health institutions listed in January 2010 by the City Health Registry and the website of the National Registry of Health Facilities (cnes.datasus.gov.br), 154 were hospitals and 57 of them met the inclusion criteria. The questionnaire was sent to these hospitals and 51 (89.5%) answered. (Fig. 2).

Table 1 shows the number of ICU beds and the number of patients seen with severe ICH per year per hospital.

With regard to the question whether the hyperventilation was performed in patients with ICH, 34 (66.7%) physiotherapists answered that this strategy was routinely performed and 17 (33.3%) do not perform it. Regarding the calculation of cerebral extraction of oxygen (CE_{O_2}), 41 (80.4%) of the ICU's do not perform it.

As regards the minimum allowed $PaCO_2$ value during the hyperventilation, from the 35 hospitals that performed this method (85%) had the objective of reaching values below 35 mmHg, four (11%)

Table 1
Characteristics of the participating hospitals.

Variables	Results
Number of patients seen per work period ^a	10 (8–12)
Number of ICU beds ^a	20 (15–31)
Patients seen with severe ICH per year per hospital	
<5 patients	6 (11.8%)
5–10 patients	8 (15.7%)
11–20 patients	14 (27.5%)
>20 patients	23 (45.0%)

ICU, intensive care unit; ICH, intracranial hypertension.

^a Median (percentile 25–75).

levels between 35 mmHg and 40 mmHg, despite the fact that many people do not consider values of 35–40 mmHg as hyperventilation, and one (3%) values above 40 mmHg.

4. Discussion

The present study aimed to evaluate the policy of hospitals in the city of São Paulo with regard to the use of the hyperventilation strategy on patients with ICH and found that this strategy is performed in 66.7% of the hospitals.

We obtained a higher percentage of returned questionnaires than that found in the literature for the same type of questionnaire. A questionnaire on treatment practices in patients with TBI in rehabilitation units in the United Kingdom was returned by only 52% of the physicians [10]. Neurosurgeons from the United States only returned 35% of 2,465 questionnaires regarding the treatment of patients with TBI [11]. Similarly, in Brazil, in a survey on the profile of physiotherapists working in ICU [12] only 39% of responses were obtained. In New Zealand 71% of 52 physiotherapists answered a questionnaire on the physiotherapy management of patients with traumatic brain injury in order to develop a Guideline on TBI [13]. We therefore consider that the 89.5% response rate gives us enough facts to support the results obtained.

In relation to the hyperventilation strategy in patients with ICH, 66.7% of the consulted hospitals reported that this maneuver is regularly performed in their ICU. Only one hospital adopts hyperventilation reaching $PaCO_2$ as low as 20 mmHg, all others that perform hyperventilation do not go under 28 mmHg of $PaCO_2$. The Brain Trauma Foundation Guidelines in the USA (2000) states that a $PaCO_2$ below 25 mmHg should always be avoided (evidence level I) and even moderate hyperventilation ($PaCO_2$ 31–35 mmHg) should not be performed in the first 24 h due to reduction in cerebral blood flow (evidence level II) [5]. Others are still more conservative and recommend that empirical hyperventilation should be avoided in cases of severe TBI not only in the first 24 h after injury but for the first 5 days post injury since the cerebral blood flow during this period is reduced and the use of hyperventilation in these cases further aggravates ischemic lesions [14].

The most recent Guidelines for the Management of Severe TBI in USA (2007) do not recommend the use of hyperventilation due to insufficient evidence for its use. In addition, it advises that if hyperventilation is indicated, $PaCO_2$ should not reach 25 mmHg [8]. Intense hyperventilation ($PaCO_2 \leq 25$ mmHg) was a technique widely used in patients with TBI in the 1980's in order to acquire a rapid reduction in ICH. However, studies conducted at that time revealed that the cerebral blood flow during the first days following brain trauma was decreased and hyperventilation caused intense additional cerebral ischemia. At this time histological evidence of cerebral ischemia in TBI patients who progressed to death was found. [8]. Despite the fact that these Guidelines do not recommend the use of hyperventilation, this strategy is still widely used in Europe to treat patients with severe TBI [9]. The same was observed in our study. However, in cases of ICH refractory to conventional

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