Monitorização não invasiva da pressão intracraniana em idosos: um relato de morfologia de onda e complacencia cerebral

Elderly non invasive intracranial pressure monitorization: a report of wave morphology and cerebral compliance

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RESUMO
A população idosa tem aumentado no Brasil e no mundo; assim, doenças e alterações fisiológicas relacionadas ao envelhecimento tornam-se cada vez mais comuns. Vários autores têm procurado reduzir a progressão das doenças em idosos e alguns deles sugerem a possibilidade de que algumas doenças possam ter seu desenvolvimento relacionado à Pressão Intracraniana Elevada (PIC). No entanto, pouco foi confirmado sobre isso devido

à invasividade das técnicas tradicionalmente utilizadas para avaliar a PIC. Existem questões sobre o diagnóstico basicamente clínico das doenças senis e o estágio de ocorrência desta alteração. Deve ser necessário identificar com precisão se as alterações da PIC em idosos são causa ou consequência das condições de saúde encontradas. Desta forma, a utilidade do monitoramento não invasivo da PIC em idosos torna-se relevante. Neste trabalho, relatamos o caso de um residente de ILPI (Centro de Longa Permanência para Idosos) com alteração significativa da complacência cerebral, após acompanhamento não invasivo da PIC. Esta mudança na morfologia da forma de onda da PIC pode estar relacionada ao uso de vários medicamentos ou à condição clínica do indivíduo com múltiplas condições relacionadas à idade.

Palavras-chave: Pressão Intracraniana (PIC), idosos, metodologia brain4Care, comorbidades em idosos, complacência cerebral.

ABSTRACT
The elderly population has increased in Brazil and worldwide; thus, diseases and physiological changes related to aging become increasingly common. Several authors have sought to reduce the progression of diseases in the elderly and some of them suggest the possibility that some diseases may have their development related to High Intracranial Pressure (ICP). However, little has been confirmed about this due to the invasiveness of the techniques traditionally used to assess ICP. Questions are raised about the basically clinical diagnosis of senile diseases and the stage of occurrence of this alteration. It must be necessary to identify precisely if ICP changes in elderly are cause or consequence of the health conditions found. In this way the utility of non-invasive ICP monitoring in elderly turns relevant. In this work we report a case of a resident at the LTCF (Long-Term Care Facility for the Elderly) with a significant change in brain compliance, after non-invasive monitoring of the ICP. This change in the waveform ICP morphology may be related to the use of multiple drugs or the age related multiple clinical condition.

Keywords: Intracranial pressure (ICP), elderly, brain4Care® methodology, elderly comorbidities, brain compliance.

1 INTRODUCTION

Currently, aging is a worldwide concern. The increase in longevity indicates that people are living longer, however it also brings up challenging themes, such as the progressive loss of physical, mental and cognitive integrity of the elderly, leading to an increased vulnerability to senile morbidities and consequent mortality (Chang *et al.*, 2017).

In this context, the 7th Brazilian Guideline for Arterial Hypertension (Malachias *et al.*, 2016), highlights Arterial Hypertension (AH) as being a predominant non-transmissible chronic disease in the elderly. It has a direct and linear relationship with age and a prevalence greater than 60% in the age group above 65 years. Vascular aging (loss

of distensibility, increased diameter and stiffening of the vessels) is the main cause of this prevalence (Malachias *et al.*, 2016).

Self-regulation of cerebral blood flow occurs in the face of changes in metabolic demands or changes in blood pressure. The vascular wall muscles are influenced by tissue vasodilators, such as CO_2. Cerebral blood flow is directly proportional to cerebral perfusion pressure (PPC) and inversely proportional to cerebral vascular resistance (RVC). Cerebral perfusion pressure is directly related to mean arterial pressure and venous pressure, which occurs parallel to intracranial pressure (ICP). The ICP reflects the relationship between brain, cerebrospinal fluid and blood and the volume of the skull. Changing the volume of one of these contents can cause intracranial hypertension, which classic symptoms are headache, visual changes, nausea and vomiting, as well as other signs, such as changes in vital signs, psychic disorders, dizziness, changes in the ability to concentration and memory and impairment of consciousness (Carlotti, Colli, Dias, 1998).

According to Andrade *et al*. (2017), older individuals tend to have a high probability of moderate or severe cognitive impairment, due to physiological changes resulting from aging. There is a hypothesis that the cumulative effects of exposure to frequent increases in intracranial pressure may contribute to the development of some diseases, such as Alzheimer's disease (AD), cerebral ischemia, neurological deficit. Some studies have shown a high incidence of AD-related injuries in patients with Normal Pressure Hydrocephalus (PNH), which is, in most cases, associated with prolonged elevation of Intracranial Pressure (Di Leva, Schmitz, Cusimano, 2013; Wostyn, 2004). In this sense, it is necessary to study ICP evaluation as an usefull tool to the care and monitoring of the elderly.

2 METHODS

The present report is a short communication of preliminary data about elderly ICP monitorization that intend present a new aproach possibility to evaluate elderly population. The procedures used in this study were approved by the Research Ethics Committee of the State University of Ponta Grossa (UEPG), linked to Plataforma Brasil - Opinion Number: 2,949,531.

Previously, the elderly woman's blood pressure was determined at 130x90mmHg. For the monitoring of intracranial pressure, the totally non-invasive brain4care® method was used. Monitoring was performed using a sensor fixed with elastic tape in the

volunteer's parietal region. This sensor captures the bone deformation resulting from the individual's intracranial pressure. The reading data were processed in the brain4care® Analytics software, defining the mean amplitude for the P1, P2 and P3 peaks for morphological analysis of the ICP and assessment of brain compliance (Frigieri *et al.*, 2018; Gomiero; Guerreiro, 2013; Mascarenhas *et al*., 2012; Vilela, 2010).

3 CASE DISCRIPTION

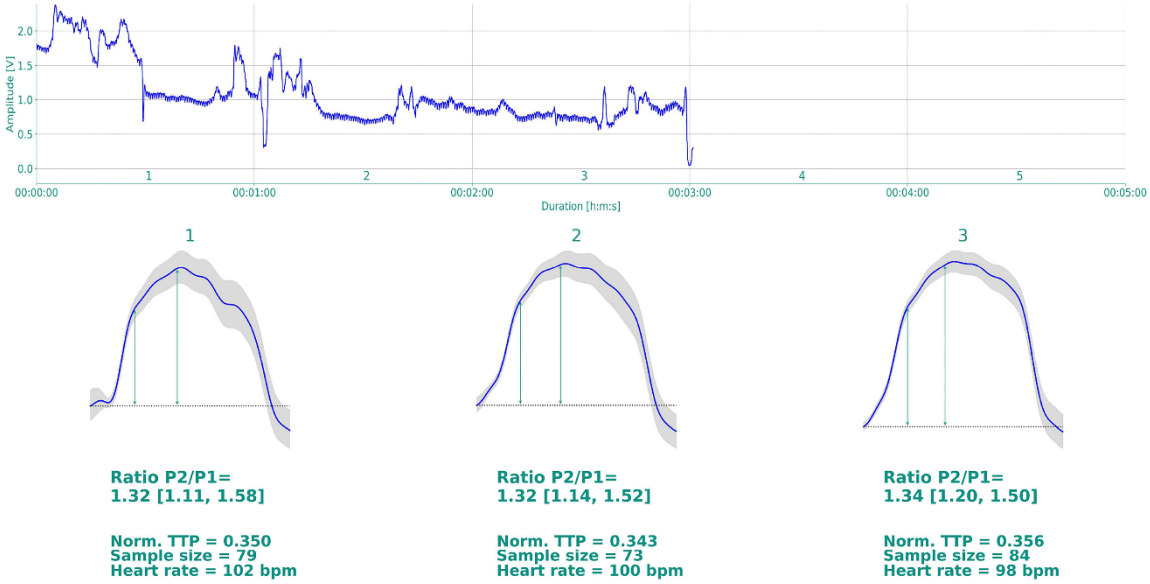
O. C., an 78-year-old woman, presented altered ICP morphology, indicating possible changes in brain compliance. The Elderly patient had psychiatric disorders and systemic arterial hypertension as comorbidities. She was able to perform some daily activities by herself. Therefore, according to the Katz Scale she is classified as independent (Lino *et al*., 2008). In addition, she is a user of bultiple therapeutic drugs, whose prescription, as well as their dosage and indication are shown in Table I.

Table I - Prescribed drugs, posology and medical indications.

DRUG (dosage)	POSOLOGY	INDICATION
Enalapril (10mg)	1 pill twice a day	ANTIHIPERTENSIVE
Mirtazapin (30mg)	1 pill once a day	ANTIACID
Periciazine (4%)	3 drops three times a day	ANTIPSYCHOTIC
Simvastatin (20mg)	1 pill once a day	ANTILIPEMIC

It was observed that the PIC waveform morphology showed the P2 / P1 rate as 1.34, indicating a possible change in brain compliance (Figure I). According to the literature available for a normal PIC curve a P1> P2 relationship (thus P2/P1 ≤1.0) is expected (Nucci *et al*., 2016).

Figure I - Elderly ICP wave form.



Legend: P2/P1 rate > 1,0 indicates cerebral compliance changes.

4 DISCUSSION

The elderly subject of this case report presented psychiatric disorder with systemic arterial hypertension and use of multiple drugs. All of them are important factors to explain the possible changes in brain compliance indicated by the ICP waveform analyzed. Multiples drugs usage is often attributed to age due to the presence of multiple morbidities (Swinglehurst, Fudge, 2019). PNH is known to be related to increased ICP (Wostyn, 2004) and is often misdiagnosed as Alzheimer's disease (Silverberg *et al*., 2006).

Aging is often accompanied by multiple chronic diseases, comorbidity, disability, frailty, and social isolation. Some of common diseases are diabetes, heart failure, osteoporosis, anemia, and hypertension (Nobili *et al*., 2011. These multiple diseases may affect organic system in such way that it would be possible to promote intracranial pressure alterations and this one may be a major risk of complication. In this case study it is possible to observe comorbidities and multiple drugs usage as long as the woman presented altered ICP. Considering it may be difficult to tackle all these different diseases and identify intracranial changes, the availability of non invasive technology may help patient attendance.

In the aging process, different physiological functions become flaws, which contributes to the increased susceptibility to different diseases and, consequently, induces

the prescription of several drugs (resulting in possible drug interactions and adverse effects; El Desoky, 2019). Due metabolic changes related to aging, different compounds may have its pharmacokinectic and biotransformation altered compared to younger subjects. Besides that, chronic diseases of the elderly may offer special risk together drug interactions and both may lead different patophysiological processes (Cadieux, 1989)

Some drugs can cause adverse reactions related to cognitive impairment, such as benzodiazepines and anticholinergics (El Desoky, 2019). Cognitive impairment in the elderly can be partly associated with hypertension, and cognitive assessment tests can be used as an alternative in clinical observation (Williams *et al.*, 2018).

The diagnosis of dementia mostly occurs after the onset of neuropathological changes, only when the patient already has clinical signs, such as loss of recent memory. Ideally, this diagnosis should occur before the onset of symptoms, allowing to predict neuropathological changes and take measures to prevent the evolution and installation of these pathologies (Steiner *et al*., 2017).

Increased ICP can promote neurological and neuropsychological disorders with clinical manifestations ranging from cognitive deficits (such as executive dysfunction, mild to moderate impairment of memory, attention, mental confusion and disorientation) to psychiatric disorders such as anxiety and depression (Moura *et al*., 2020).

The brain4care® method for non-invasive monitoring of ICP and brain compliance can be a useful way to monitor the elderly population and clarify the natural history of the development of senile diseases, especially neurological disorders / dementia (Frigieri *et al.*, 2018). Unfortunately, there is no previous data to clarify the moment when the ICP became changed. It possibly would be the cause of the psychiatric disorder or a consequence of one or more physiological changes. ICP could be increased as side effect of multiples drugs or due to morbidities.

5 CONCLUSION

This report present a way to establish, through new studies, how multiple conditions contribute to the decline in the functions of the elderly. Therefore, the introduction of a clinical evaluation tool that allows to identify in a simple, safe, non-invasive and painless way, changes in the morphology of the ICP waveform and brain compliance is justified to establish a more accurate diagnosis, in addition to using it in the clinical routine as an important vital sign to be monitored. Thus, it could be a practical tool to assist in early diagnosis, treatment, prevention and contribute to the quality of life

in the face of an aging population. Here we present a subject data afford to publicize ICP alteration as na important condition to promote higher risk to elderly life.

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