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Research Article

Transcranial Doppler (TCD) Interest for Early Care in Post-Traumatic Intra-Parenchymal Hematomas Not Accessible to Surgery

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Abstract

Introduction: The transcranial Doppler (TCD) is an integral part of the initial care of the head trauma patient. The study objective was to assess the interest of TCD for the early care in post-traumatic intra-parenchymal hematomas not accessible to surgery

Methods: It is a prospective cohort study on the early care of post-traumatic intra-parenchymal hematomas observed at the Surgical intensive care of the Joseph Ravoahangy Andrianavalona University Hospital, Antananarivo, Madagascar over a period of one year, from January 2019 to December 2019. All patients with and without TCD were followed during the first 5 days of hospitalization. Neurological progression and patient condition were the primary outcome.

Results: 47 patients were retained. Among them, 16 patients or 34.04% had benefited from a TCD. The patients average age was 54.10 +/- 12.05 years with a sex ratio 1.76 (30/17). At admission, all patients were comatose. Anisocoria was observed in 21 patients or 44.68% of the cases. The majority of the patients had high blood pressure at admission (70.21%). Regarding biological assessments, hyponatremia was the most observed (34.03%). The worsening of the neurological state was tripled in patients who did not benefit from TCD (RR: 3.22 [1.43 - 7.27], p = 0.003,). In contrary, there was no significant difference in early mortality (first 5 days) for the 2 groups (RR: 0.95 [0.47 - 1.91], p = 0.57).

Conclusion: The transcranial Doppler is an important tool for the care of brain injury in the acute phase.

Keywords: *Transcranial Doppler; Brain Monitoring; Pulsatility Index; Management*

Introduction

Brain-damaged care has experienced a technological revolution over the past three decades. Although clinical examination remains a central part of evaluation, follow-up and prognosis, it remains nevertheless limited in patients with impairment consciousness. For resuscitators, the goal of treatment consists, after controlling the primary brain attacks, in limiting central and systemic secondary brain attacks. All these measures lead to ensuring a balance between energy intake and cerebral metabolism, in order to prevent the onset of secondary cerebral ischemia, which can negatively impact the patients prognosis [1-3]. Transcranial Doppler (TCD) is an integral part of the initial management of the head trauma. TCD is used to assess cerebral perfusion through flow velocities and, indirectly, to assess intracranial pressure [4]. The study objective was to assess TCD interesting the early care of post-traumatic intra-parenchymal hematomas not accessible to surgery.

Methods

This is a prospective cohort study on the early care of post-traumatic intra-parenchymal hematomas at the Surgical intensive care of the Joseph Ravoahangy Andrianavalona University Hospital Center, Antananarivo, Madagascar, over a period of one year, from January 2019 to December 2019. All serious trauma with intra-parenchymal hematomas not accessible to surgery, aged 15 or more, were included in the study, regardless of gender. All patients with and without TCD were followed during the first 5 days of hospitalization. As the Surgical intensive care does not have TCD equipment, the examination was carried out in the Medical Imaging Department. The realization of TCD depends on the financial means of the patients. Neurological progression and patient conditions were the primary outcome. Secondly, we excluded from the study all the patients transferred to another hospital before the follow-up period (5 days). The data was analyzed with Epi-info 7 software. Being a cohort study, Relative Risk (RR) is the main association measure to assess the relationship between TCD practice and patient outcomes.

The Chi-2 test or the Fischer test was used to compare the qualitative variables. Student's t-test was used to compare the means. The difference was considered as significant for a p value under 0.05.

Results

Forty-seven patients were retained. The average age of the patients was 54.10 +/- 12.05 years with a sex ratio of 1.76 (30/17). High blood pressure (76.60%), alcoholism (55.32%) and smoking (42.55%) were the most common medical histories. Table 1 shows the distribution of patients according to medical history.

History	Effective (n = 47)	Proportion (%)
HBP	36	76.60
Alcoholism	26	55.32
Smoking	20	42.55
Stroke	4	8.51
Diabetes	2	4.26
Asthma	1	2.13

Table 1: *Distribution of patients according to medical history.*
HBP: High Blood Pressure.

At admission, all patients were comatose. Anisocoria observed in 21 patients, or 44.68% of the cases. The majority of patients had high blood pressure in admission (70.21%). Regarding laboratory tests, hyponatremia was the most observed in biological checkup (34.03%). Table 2 represents the distribution of patients according to clinical signs and biological abnormalities in admission.

Characteristics	Effective (n = 47)	Proportion (%)
Clinical signs		
Coma	47	100
Anisocoria	21	44.68
Myosis Tight	12	25.53
Bilatera areactive semi mydriasis	2	4.26
Fever	7	14.89
SBP < 90 mmHg	0	0
SBP [90 - 140]	14	29.78
HBP	33	70.21
Biological anomalies		
Anemia	4	8 .51
Hyponatremia	16	34.03
Hypernatremia	5	10.64

Table 2: *Patients distribution according to clinical signs and biological abnormalities in admission.*
SBP: Systolic Blood Pressure; HBP: High Blood Pressure.

Regarding care, all patients in both groups were intubated, sedated and placed on mechanical ventilation. They also benefited from a vascular filling with an isotonic saline serum. The average target of blood pressure was between 80 and 90 mmHg. Norepinephrine was the vasopressor of choice for low blood pressure. Nicardipine was indicated in patients with an Average Blood Pressure (ABP) greater than 110 mmHg. Correction of all electrolyte disturbances was carried out. Four patients (8.51% of cases) had severe anemia requiring a blood transfusion with the target hemoglobin level greater than 9 g/dl.

For patients without neurological monitoring (without TCD), osmotherapy is indicated in the event of Intracranial High Pressure (ICHP) clinical signs and/or cerebral engagement. For the other group, it is indicated in the event of the TCD abnormality (Pulsatility index (PI) > 1.25 and diastolic velocity < 25 cm/s in the proximal portion of the middle cerebral artery).

If osmotherapy failed, a decompressive craniectomy was indicated for the 2 groups.

Among the 47 patients, 16 cases or 34.04% had performed a TCD. The worsening of the neurological state was tripled in patients who did not TCD benefit (RR: 3.22 [1.43 - 7.27], p = 0.003). This result could be explained by the early detection of ICHP signs by TCD and treatment anticipation. Table 3 recalls the distribution of patients according to evolution.

Characteristics	With TCD	Without TCD	RR	P-value
Worsening neurological condition				
Yes	6	25	3.22 [1.43 - 7.27]	0.003
No	10	6		

Table 3: *Distribution of patients according to evolution.*

Our mortality rate was 57.45%, there was no significant difference for the 2 groups (RR: 0.95 [0.47 - 1.91], p = 0.57). Table 4 represents the correlation between the practice of TCD and mortality.

Characteristics	Deaths	Survivors	RR	P-value
TCD				
Yes	9	7	0. 95 [0.47 - 1.91]	0.57
No	18	13		

Table 4: *Correlation between TCD and mortality.*

For patients with TCD, mortality rate was similar for patients with normal PI and high PI (p = 0.32). Table 5 shows the correlation between PI and mortality. This could be explained by the precociousness of ICHP treatment.

PI	Deaths	Survivors	Effective TCD (n = 16)	P-value
Normal (PI = 1,0 +/- 0,2)	3	4	7	0,32
Abnormal (PI > 1,25)	6	3	9	

Table 5: *Correlation between mortality and PI.*

Discussion

In our study, no significant difference in terms of early mortality (first 5 days) for the group of patients who benefited from TCD monitoring of the cerebral hemodynamics compared to the other group. However, we were able to detect early signs of intracranial

hypertension and anticipate the necessary treatment. For the group of patients without monitoring, the diagnosis was late and many patients showed signs of neurological deterioration. TCD aims to assess brain perfusion through flow velocities and, indirectly, to assess intracranial pressure [4]. Few studies have analyzed the development of cerebral flows of brain trauma patients upon arrival at hospital. These studies discuss either the prognostic interest of the drop in the isolated average Velocity below 28 cm/s [5], or the need to take into account the association of a low average Velocity and a high PI [6].

The velocity thresholds analysis found in 36 children as a factor of poor prognosis, either a Diastolic Velocity less than 25 cm/s, or a PI greater than 1.3 [7]. All moderate head injuries, Glasgow score between 8 and 14, examined in the emergency room of the Grenoble University Hospital, which worsened in the next few hours had a PI greater than or equal to 1.4 on arrival in the emergency room [8]. The teams are therefore moving towards an analysis related to PI and Diastolic Velocity. A strategy for the reception of these patients centered on the results of TCD upon arrival, before any CT scan, has been specified [9]. The severity thresholds used are the association of a PI greater than or equal to 1.4 and a diastolic Velocity less than 20 cm/s. Twenty-four head injuries were studied on arrival. The TCD carried out within 20 minutes after their arrival in the blistering room shows that 46% of these brain trauma victims met these severity criteria. The Average Blood Pressure (ABP) was no different in the group with high ischemic risk for TCD and in the group with normal TCD. Immediate treatment (mannitol and/or increased ABP with norepinephrine) quickly corrects the dangerous drop in flow in the risk group. This processing saves the time necessary for the organization of additional examinations under safe conditions. Brain CT then makes it possible to analyze the type of brain damage and organize a more durable treatment such as the operating room or hypothermia [10].

Conclusion

Preventing and controlling secondary brain damage will improve the prognosis for brain injured patients. The Surgical Resuscitation Service should provide a transcranial doppler, which is a major tool for early detection of the presence of intracranial hypertension with repercussions on cerebral hemodynamics and for judging the effectiveness of the therapeutic measures implemented to maintain the pressure of cerebral perfusion.

Conflicts of Interest

The authors declare no conflict of interest.

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