The Professional Medical Journal
www.theprofesional.com

DOI: 10.17957/TPMJ/17.3840

ORIGINAL PROF-3840

HYPERTENSIVE HEMORRHAGIC STROKE;

EFFECTIVENESS OF INTRACRANIAL PRESSURE MONITORING IN PATIENTS AT A TERTIARY CARE HOSPITAL IN KARACHI, PAKISTAN

Fazal ur Rehman[1], Sikander Idrees[2], Muhammad Hashim[3], Syed Maroof Hashmi[4]

1. FCPS Part II Trainee
   Department of Neurosurgery,
   Civil Hospital Karachi,
2. Post Graduate Trainee,
   Department of Neurosurgery,
   Dow University of Health Sciences.
3. FCPS Part II Trainee,
   Abbasi Shaheed Hospital, Karachi.
4. Senior Registrar,
   Department of Neurosurgery,
   Abbasi Shaheed Hospital, Karachi.

Correspondence Address:
Sikander Idrees,
Post Graduate Trainee,
Department of Neurosurgery,
Dow University of Health Sciences
drsikander.neurosurgery@gmail.com,

Article received on:
23/01/2017
Accepted for publication:
25/05/2017
Received after proof reading:
08/08/2017

ABSTRACT… Objectives: The aim of our study is to evaluate the use of intracranial pressure monitoring as a predictor of neurological deterioration in patients with hemorrhagic stroke and evaluate the relationship of continuous intracranial pressure monitoring with warning signs of brain herniation and hematoma enlargement in our setup. **Study Design:** Randomized controlled trial. **Period:** 02 years duration from June 2014 to June 2016. **Setting:** Tertiary Care Hospital in Karachi Pakistan. **Method:** Patients in group A had continuous monitoring of the intracranial pressures by having an implant device placed under general anesthesia. Both groups were given the required treatment as per guideline, including blood pressure reduction, diuretic and mannitol as per requirement. Both the groups were assessed clinically after every 8 hours in the initial three days and then every day till no deterioration were observed for 5 days (pupils, reflexes, extremity test etc) and a repeat CT scan was performed at 24 hours after the onset of initial stroke. While in the control group pressures were monitored using neurological signs and clinical measurements, and the dose of mannitol was adjusted accordingly. The outcome was assessed within 1 month duration from the onset of hemorrhagic stroke, and the parameters used were hematoma progression and herniation of the brain. **Results:** The patient population consisted of n= 100 patients, who presented to our hospital with a primary diagnosis of hemorrhagic stroke, as confirmed by CT scan. The patient population was divided into two groups using a random number generator, group A consisted of the patients who underwent intracranial pressure monitoring and had n= 52 patients, while group B consisted of the control group (no objective ICP measurement) and had n= 48 patients in the group. The incidence of enlargement of the hematoma in group A was n= 16 (30.76%) and in the control group was n= 18 (37.5%). And when it comes to brain herniation n= 6 (11.53%) patients developed it in the ICP monitoring group and n= 10 (20.833%) developed it in the control group respectively. We found that the mortality rate in our study population was n= 4 (7.69%) in ICP monitoring group and n= 5 (10.41%) in the control group having a p value of 0.04, the neurological outcome in the two groups also had statistically significant differences, having a p value of 0.03. **Conclusion:** In our study we found a lower incidence of secondary brain herniation in patients who underwent continuous intracranial pressure monitoring as compared to control group, furthermore these patients had better neurological outcomes.

Keywords: Intracranial pressure, ICP, monitoring, hemorrhagic stroke, brain herniation.

Article Citation: Fazal ur Rehman, Idrees S, Hashim M, Hashmi SM. Hypertensive hemorrhagic stroke; Effectiveness of intracranial pressure monitoring in patients at a tertiary care hospital in Karachi, Pakistan. Professional Med J 2017;24(8):1195-1199. **DOI:** 10.17957/TPMJ/17.3840

INTRODUCTION

Hemorrhagic stroke has the highest rate of mortality among all the different types of stroke diseases, and for the evaluation of neurological deterioration the growth of hematoma is the most reliable predictor, thus in clinical settings it is used as an early warning sign for major neurological dysfunction.[1,2] In patients with severe traumatic brain injury intracranial pressure (ICP) monitoring is used as standard of care, but its use is not well studied in patients who suffered from hemorrhagic stroke. Following cerebral hemorrhage intracranial pressure rises which leads to enlargement of the hematoma, herniation of brain, midline shift and worsening of the neurological outcomes. There exists many different ways to evaluate the intracranial pressure such as direct detection of the pressure

or indirectly through clinical signs and radiologic evaluation. Conventionally a decreasing clinical status is followed by computer tomographic (CT scan) analysis to evaluate a need for intervention. But this can likely be delayed due to delay in observing the clinical signs and symptoms and subjective assessment of the evaluating physician. In contract observing the intracranial pressure directly provides better detection and changes of the pressures and help guide the necessary intervention. The aim of our study is to evaluate the use of intracranial pressure monitoring as a predictor of neurological deterioration in patients with hemorrhagic stroke and evaluate the relationship of continuous intracranial pressure monitoring with warning signs of brain herniation and hematoma enlargement in our setup.

MATERIALS AND METHODS

The type of study is a randomized controlled trial, conducted for a period of 2 year duration from June 2014 to June 2016, at a tertiary care hospital in Karachi Pakistan. All patients included in the study signed a duly informed consent and in case of patient being unable to do so, the informed consent was taken from next of kin, the study was approved by the hospital ethics committee. The inclusion criteria was all the patients who presented to our accident and emergency department with hemorrhagic stroke (intracerebral hemorrhage) and admitted in our neurosurgical unit, the cause for hemorrhage was hypertension, the patients did not already have intraventricular hemorrhage initially and/or herniation of the brain and all the patients were admitted within 6 hours of the onset of hemorrhagic stroke.

The exclusion criterion was all the patients who had previous history of cerebrovascular disease or were taking anti-coagulant medications, also those patients who had other neurological co morbidities like aneurysm or arteriovenous malformations were also excluded from the study and treated at our setup as routine. The patient population was divided into two groups, the study group (group A) and the control group (group B) using a random number generator. Patients in group A had continuous monitoring of the intracranial pressures by having an implant device (Codman neuro, ICP monitoring system USA, which contains a transducer which consists of a strain pressure gauge, this sensor monitors the intracranial pressure and information is relayed to the device screen electronically) placed under general anesthesia, the device was placed in the lateral ventricle (anterior horn), which allowed drainage of the CSF.[3] External ventricular drain was placed in the contra lateral side so as to avoid hematoma formation. The gold standard for measurement of global intracranial pressure is ventricular ICP measurement.[4]

Both groups were given the required treatment as per guideline, including blood pressure reduction, diuretic and mannitol as per requirement. Both the groups were assessed clinically after every 8 hours in the initial three days and then every day till no deterioration were observed for 5 days (pupils, reflexes, extremity test etc) and a repeat CT scan was performed at 24 hours after the onset of initial stroke. Mannitol or diuretics were administered if the ICP was found to be more than 25mm of Hg, and CSF was drained to lower the pressures, to maintain an osmotic pressure of 280-320 osmol/L diuretics were given at 8 hour intervals, and a repeat CT scan was performed if the intracranial pressure failed to lower down with these afore mentioned methods for 15 min duration, to see the hematoma progression. While in the control group pressures were monitored using neurological signs and clinical measurements, and the dose of mannitol was adjusted accordingly. The outcome was assessed within 1 month duration from the onset of hemorrhagic stroke, and the parameters used were hematoma progression and herniation of the brain.

Expansion of the hematoma was defined as when the patients repeat CT scan showed a new lesion or an increase of greater than or equal to 25% of the original volume of the hematoma.[6] The Bayesian compressive sensing method was used to calculate the volume of the hematoma.[7] While the brain herniation was defined as a worsening of the patients Glasgow coma scale score to 3-8, with one or both pupils dilated and

failed to constrict on the light reflex performed, and confirmed with a CT scan.[8] For measurement of the secondary outcome Glasgow outcome scale (GOS) was used at 3 months to 6 months post onset of initial bleeding episode. Data was analyzed using SPSS version 20, chi square and unpaired t test was used to analyze the patient characteristics when it comes to ordinal variables, while chi square and fisher's exact tests were used to analyze the incidence data. A p value of less than 0.05 was considered to be statistically significant.

RESULTS

The patient population consisted of n= 100 patients, who presented to our hospital with a primary diagnosis of hemorrhagic stroke, as confirmed by CT scan. The patient population was divided into two groups using a random number generator, group A consisted of the patients who underwent intracranial pressure monitoring and had n= 52 patients, while group B consisted of the control group (no objective ICP measurement) and had n= 48 patients in the group. The demographic variables of the patients such as age, gender, time duration from onset to presentation at the hospital, GCS scores etc are listed in Table-I. No significant difference was found in the demographic variables of the two patient groups. In majority of the patient population there was an incidence of enlargement of the hematoma at 3 to 10 days post onset of initial hemorrhagic episode. The incidence of enlargement of the hematoma in group A was n= 16 (30.76%) and in the control group was n= 18 (37.5%). And when it comes to brain herniation n= 6 (11.53%) patients developed it in the ICP monitoring group and n= 10 (20.833%) developed it in the control group respectively. All the patients who had brain herniation underwent a procedure to drain the hematoma, also we did not find any side effect related to the ICP monitoring system in the patient population. We found that the mortality rate in our study population was n= 4 (7.69%) in ICP monitoring group and n= 5 (10.41%) in the control group having a p value of 0.04, the neurological outcome in the two groups also had statistically significant differences, having a p value of 0.03. Refer to Figure-1.

Characteristics	Group A (ICP monitoring group)	Group B (control group)	P value
Number of patients	52	48	
Age in years	42 (20-60)	43 (19-62)	0.12
Gender			0.49
Male	38	33	
Female	14	15	
Time duration between onset to admission in hours	2.45 +/- 0.6	2.35 +/- 0.81	0.58
GCS scores at the time of admission	10 +/- 1	11 +/- 1	0.92
Systolic pressure in mm of Hg	168 +/- 15	169 +/- 12	0.44
Location of the hematoma			0.83
Right	19	18	
Left	33	30	
Volume of the hematoma in mls	19 +/- 6	20 +/- 5	0.67
Brain herniation	6	10	0.04
Enlargement of the hematoma	16	18	0.76

Table-I. Various variables of the patients belonging to the ICP monitoring and control group

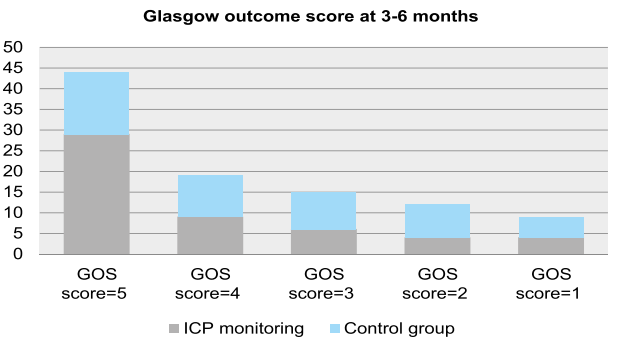


Figure-1. Glasgow outcome score of patients at 3-6 months duration.

DISCUSSION

According to the results of our study we found that the patients belonging to the intracranial pressure monitoring group experienced less secondary brain herniation in the 1 month post onset period, also these patients had better Glasgow outcome scores hence the neurological

outcome as compared to the control group. Which showed that objective measurement of intracranial pressure can guide the management of a hemorrhagic stroke patient better than serial CT imaging and neurological examination. When it comes to the hypertensive Intracerebral hemorrhage the hematoma expands before the brain edema which follows suit gradually. The enlarging hematoma and ensuing edema of the brain parenchyma leads to a decrease in the intracranial volume reserve, which is followed by a due rise in the intracranial pressure, which causes further damage of the cerebral vascular auto regulation and further decreases the brain perfusion, and deterioration of the outcome. Thus early detection and management of this increased intracranial pressure decreases the morbidity and mortality of the patients with hemorrhagic stroke. However the research in this area is lacking and there are only a few studies which studied the effect of ICP monitoring with outcomes specially the outcomes of hematoma enlargement and brain herniation, and specially from this part of the globe.

In patients with severe hypertension a sudden change of the blood pressure can lead to rebleeding and enlargement of the hematoma, which increases the intracranial pressure, thus continuous monitoring allows early detection of these changes, clinically a raised intracranial pressure of greater than 30 mm of Hg lasting for more than 15 minutes, prompts immediate CSF draining and urgent CT scan to observe the changes in the hematoma, which after evacuation would decrease the intracranial pressure to less than 20mm of Hg, which predicts a suitable outcome. Although the monitoring of Intracranial pressures cannot have an influence on the incidence of brain herniation but this monitoring leads to increase in the patient care by the nursing staff, along with the pharmacologic management such as anti hypertensive's, diuretics, haemostatic control, all these forms of medications can be better observed and adjusted based on the dynamic intracranial pressure values, and be compared to the clinical signs and radiological data.

In our study we did not observe any side effects such as infections and ventricular hemorrhage but such side effects are an established risk of continuous intracranial pressure monitoring systems.[9] The limitation in our study was that it was a single centre study, therefore we recommend that further studies be done to evaluate larger study sample and compare and contrast ICP monitoring in patients with Intracerebral hemorrhage to patients having intraventricular hemorrhage.

CONCLUSION

In our study we found a lower incidence of secondary brain herniation in patients who underwent continuous intracranial pressure monitoring as compared to control group, further more these patients had better neurological outcomes.

REFERENCES

1. Broderick J, Connolly S, Feldmann E, Hanley D, Kase C, Krieger D, Mayberg M, Morgenstern et al, American Heart Association/American Stroke Association Stroke Council; American Heart Association/American Stroke Association High Blood Pressure Research Council; Quality of Care and Outcomes in Research Interdisciplinary Working Group: Guidelines for the management of spontaneous Intracerebral hemorrhage in adults: 2007 update: a guideline from the American heart association/American stroke association stroke council, high blood pressure research council, and the quality of care and outcomes in research interdisciplinary working group. Stroke 2007, 38:2001–2023.

2. Brouwers HB, Greenberg SM: **Hematoma expansion following acute intracerebral hemorrhage.** Cerebrovasc Dis 2013, 23:195–201.

3. Zeng JS, Tong WS, Zheng P: **Decreased risk of acute kidney injury with intracranial pressure monitoring in patients with moderate or severe brain injury.** J Neurosurg 2013, 119:1228–1232.

4. Wartenberg KE, Schmidt JM, Mayer SA: **Multimodality monitoring in neurocritical care.** Crit Care Clin 2007, 23:507–538.

5. Ramandeep Sahni JW: **Management of intracerebral hemorrhage.** Vasc Health Risk Manag 2007, 3:701.

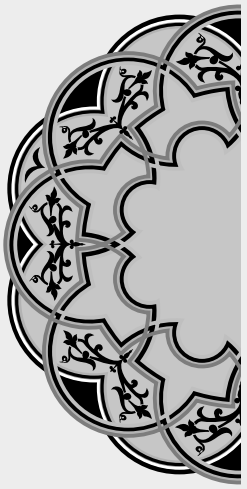
6. Tong WS, Zheng P, Xu JF, Guo YJ, Zeng JS, Yang WJ, Li GY, He B, Yu H: **Early CT signs of progressive**

hemorrhagic injury following acute traumatic brain injury. Neuroradiology 2011, 54:305–309.

7. Kothari RU, Brott T, Broderick JP, Barsan WG, Sauerbeck LR, Zuccarello M, Khoury J: **The ABCs of measuring intracerebral hemorrhage volumes.** Stroke 1996, 27:1304–1305.

8. Gruen P: **Surgical management of head trauma.** Neuroimaging Clin N Am 2002, 12:339–343.

9. Blaha M, Lazar D: **Traumatic brain injury and haemorrhagic complications after intracranial pressure monitoring.** J Neurol Neurosurg Psychiatry 2005, 76:147.



"Quarrels end,
but words once spoken never die."

African Proverb

AUTHORSHIP AND CONTRIBUTION DECLARATION

Sr. #	Author-s Full Name	Contribution to the paper	Author=s Signature
1	Fazal ur Rehman	Data collection, Concept, Literature review, Write up, analysis	
2	Sikander Idrees	Data collection and analysis, drafting, corresponding author	
3	Muhammad Hashim	Literature review, write-up, analysis	
4	Syed Maroof Hashmi	Literature review, write-up, analysis, proof reading	