

Delayed rise in intracranial pressure in patients with head injury

Pankaj Ailawadhi MS, Deepak Agrawal M Ch, BS Sharma M Ch

Department of Neurosurgery, JPN Apex Trauma centre, AIIMS, New Delhi

Abstract: This prospective study was done on patients of severe and moderate head injury (GCS \leq 12) admitted in the department of neurosurgery over a two month period to evaluate the significance of delayed rise in intracranial pressure in patients with severe and moderate head injury and to see for any correlation with CT head findings and neurological outcome. Patients who presented within 8 hours of injury and in whom intracranial pressure (ICP) monitoring was done were enrolled in the study. Patients were managed as per departmental protocols. Based on serial intracranial pressure patients were divided in three groups: Initial high ICP group (IHICP group) consisting of patients with initial high ICP value of >20 cm H₂O. Delayed high ICP group (DHICP group) consisting of patients with initial normal ICP <20 cmH₂O with a delayed rise after a variable period (24-96 hrs), & normal ICP group (NICP group) comprising patients with persistently normal ICP of < 20 cmH₂O. A total of 21 patients were enrolled in the study. All were males with a mean age of 33 years. 17 (80.9%) patients had severe head injury (GCS d" 8) and 4 (19%) patients had moderate head injury (GCS 9 e" 12). There were five patients in IHICP group with a mean initial ICP of 35 cmH₂O. Three (60%) patients in this group had effaced cisterns on CT whereas remaining two had grossly normal CT scans. All patients in this group were operated within 24 hours of injury and had excellent recovery with a mean GOS of 3.4. There were six patients in DHICP group with a mean initial ICP of 12 cmH₂O. Four (66%) patients had effaced cisterns on initial CT and two had grossly normal CT scans. Mean ICP rose to 30 cmH₂O (range 21-40 cmH₂O) over a mean period of 66 hours (range 24-192 hours). All patients in this group were also operated. The mortality in this group was 50% (n=3) with mean GOS of 2. NICP group had 10 patients with mean ICP value of 13 cmH₂O. Eight (80%) of these patients had normal CT Scans whereas two patients had effaced cisterns on initial CT. All patients in this group were managed conservatively with good recovery (mean GOS3.2). Patients of head injury with effaced cisterns on CT head and delayed rise in ICP had the worst outcome in our study. This the first study of its kind showing correlation between delayed rise in ICP and outcome. More studies are warranted to assess whether early surgery in this group of patients could improve outcome.

Keywords: Complications, Head injury, Intracranial pressure, ICP monitoring

INTRODUCTION

The earliest descriptions of ICP monitoring date back almost 100 years¹. Most significant advances in this area, however, have occurred over the last three decades^{2,3,4,5,6}. With technological refinements, the process of monitoring has become more elegant, reliable, and safe^{5,6,7,8,9}. Consequently, it is being increasingly applied in a variety of neurological disease states, especially traumatic coma. In 1977, Becker and colleagues¹⁰ suggested that monitoring intracranial pressure (ICP) in severely head-injured patients (GCSd" 8) should be included in a regimen of vigorous surgical and medical

therapy to prevent or reverse secondary cerebral insults, thereby improving outcome¹¹. To define the indications for ICP monitoring, a number of investigators subsequently tried to establish a relationship between abnormal features on computerized tomography (CT) and elevated ICP including the presence of a mass lesion, midline shift, dilatation of the contralateral ventricle, loss of the image of the third ventricle, and obliteration of the mesencephalic cisterns¹²⁻¹⁶. However, for the individual neurosurgeon faced with the question "when to monitor and when to directly proceed with surgery" no clear guidelines exist.

Also, it has been the authors' experience that in some patients with head injury the initial ICP readings are within the normal range and become high after a variable time period necessitating delayed surgical intervention. It can be argued that these patients possibly could have a better outcome if they were operated early rather than in a delayed fashion. In this study we try to evaluate the

Address for Correspondence :

Dr Deepak Agrawal

Assistant professor

Department of Neurosurgery, All India Institute of Medical Sciences
New Delhi, India. Email: drdeepak@gmail.com

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significance of delayed rise in intracranial pressure in patients with severe and moderate head injury and to see for any correlation with CT head findings and neurological outcome

MATERIALS AND METHODS

This prospective study was done on patients of severe and moderate head injury ($GCS \leq 12$) admitted in the department of neurosurgery over a two month period. Patients who presented within 8 hours of injury and in whom intracranial pressure (ICP) monitoring was done were enrolled in the study. Patients were managed as per departmental protocols. In all patients, CT scans of the head were studied for the presence of mass effect, midline shift and effacement of basal cisterns. Serial CT scans were carried out routinely after 24 hours of admission and subsequently depending on patient's neurological status. All patients had ICP monitored using a parenchymal ICP monitoring system (Codman®) usually for 3 days, and longer if the ICP remained elevated. Average ICP measurements were recorded every hour. On serial intracranial pressure patients were divided in three groups: Initial high ICP group (IHICP group) consisting of patients with initial high ICP value of >20 cmH₂O. Delayed high ICP group (DHICP group) consisting of patients with initial normal ICP <20 cmH₂O with a delayed rise after a variable period (24-96 hrs), & normal ICP group (NICP group) comprising patients with persistently normal ICP of <20 cmH₂O. Outcomes of the patients were defined according to the Glasgow Outcome Scale (GOS).

RESULTS

A total of 21 patients were enrolled in the study. All were male with a average age of 32.8 years. Median age was 30 with a range of 15 – 50 years. 18 (85.7%) patients had severe head injury ($GCS \leq 8$) and 3 (14.3%) patients had moderate head injury ($GCS 9 \geq 12$).

Outcome in different groups:

IHICP group

There were five patients in IHICP group with a mean initial ICP of 35 cm H₂O. Three (60%) patients in this group had effaced cisterns on CT whereas remaining two had grossly normal CT scans. All patients in this group were operated within 24 hours of injury and had excellent recovery with a mean GOS of 3.2.

DHICP group

There were six patients in DHICP group with a mean initial ICP of 12 cm H₂O. Four (66%) patients had effaced cisterns on initial CT and two had grossly normal CT scans. Mean ICP rose to 30 cm H₂O (range 21-40 cmH₂O) over a mean period of 66 hours (range 24-192 hours). All patients in this group were also operated. The mortality in this group was 50% (n=3) with mean GOS of 2. Correlation between these two variables of delayed ICP rise resulting in delayed surgery and increased mortality in this subgroup was found to be statistically significant ($p < 0.005$).

NICP group

NICP group had 10 patients with mean ICP value of 13 cm H₂O. Eight (80%) of these patients had normal CT Scans whereas two patients had effaced cisterns on initial CT. All patients in this group were managed conservatively with good recovery (mean GOS 3.2).

DISCUSSION

Severely head-injured patients whose initial CT scan is normal or does not show a mass lesion, midline shift, or abnormal cisterns have been considered to be at low risk for developing intracranial hypertension. But moderately or severely head injury patients with initial abnormal CT findings and normal ICP tracings are the ones that need the maximum attention as the delayed rise in ICP in these patients with subsequent deterioration can take away the benefits that early surgery could have given to such patients. Although there are no comparable studies, Narayan¹⁷ et al have analyzed their experience with intracranial pressure (ICP) monitoring in 207 patients over a 4-year period. Patients with either high-density or low-density lesions on computerized tomography (CT) at admission had a high incidence (53% to 63%) of intracranial hypertension (ICP persistently over 20 mm Hg). In contrast, patients with normal CT scans at admission had a relatively low incidence of ICP elevation (13%). A recent study by Galbraith and Teasdale¹⁸ on patients with traumatic intracranial hematomas in whom the surgeon was undecided about the need for surgery, indicates that all patients with ICP's above 30 mm Hg eventually deteriorated and required surgery. This rarely happened in those patients with an ICP below 20 mm Hg. Patients in the 20 to 30 mm Hg range were about evenly divided between the surgical

and nonsurgical groups. This study exemplifies the value of ICP monitoring as an early-warning system that allows appropriate measures to be taken before actual neurological deterioration occurs. This and many other studies have shown the benefits of ICP monitoring in avoiding surgery when the initial CT Scan was normal. High intracranial pressure (HICP) may be a very early event after traumatic brain injury (TBI), but in most cases, especially when contusions and edema develop over time, HICP will worsen over succeeding days. A study by Stocchetti¹⁹ et al describes the incidence and severity of elevated intracranial pressure (ICP) after TBI and attempts to document its time course. In this prospective study, 201 TBI patients in whom ICP was monitored for more than 12 h were evaluated. ICP was measured, digitalized, and analyzed after manual filtering. The number of episodes of HICP and the mean ICP value for every 12-h interval were calculated. When monitoring was concluded, the highest mean ICP collected in every patient was identified. A total of 21,000 h of ICP monitoring were recorded. Active treatment to prevent or reduce HICP was used in 200 patients. HICP was documented in 155 cases. Half of the patients had their highest mean ICP during the first 3 days after injury, but many showed delayed ICP elevation, with 25% showing highest mean ICP after day 5. In these cases, HICP was significantly worse and required more intense therapies. The main question that the present study raises is whether or not CT scanning can identify a group of patients who could just benefit from early surgery without going through initial ICP monitoring and thus preventing the delay that sometime occurs because of initial low ICP values.

CONCLUSION

Though the size of the study cautions us against reaching a conclusion but patients of head injury with effaced cisterns on initial CT head and delayed rise in ICP in our study had the worst outcome. More studies are warranted to assess whether early surgery in this group of patients could improve outcome.

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