

Original Article

## A Study to Describe Cerebral Perfusion Pressure Optimization Practice among ICU Patients of Tertiary Hospital of South India

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### Abstract

**Background:** The maximum numbers of ICU admission are due to traumatic cases leading to physiological insult to the brain directing to impaired cerebral perfusion. Thus maintenance of cerebral perfusion is an important area to be looked into among ICU patients

**Aims:** Assessing the practice of cerebral perfusion pressure optimization.

**Methodology:** A descriptive survey study was done by cerebral perfusion pressure maintenance checklist and was used for 29 patients of Neurosciences ICU to observe the practice Kasturba Hospital, Manipal. Data was collected for the period of three month from January to March 2014. Descriptive statistics were used to explain the findings.

**Results:** The observation of cerebral perfusion maintenance practice revealed that there was 100% monitoring of vital signs, GCS and pupillary reaction. The blood pressure was maintained among 86.20% and 13.79% were given vasopressure agent. Majority 65.75% used mechanical ventilation through endotracheal tube. Inj Mannitol was used among 75.86% and Inj Lasix among 79.31% of patients in Neuro ICU for osmotherapy; hypertonic saline was not practiced. Most of patients received Inj Phenytoin for anti seizure measure whereas use of sedation and muscle relaxant was not observed. Among surgical management 24.13% was managed with extra ventricular drainage and 51.72 % underwent craniotomy.

**Conclusion:** The standardized guideline for cerebral perfusion pressure maintenance for uniformity and effective case management and improve outcome is essential to be established.

**Key word:** Cerebral perfusion pressure, CPP optimization practice, ICU patient

### Introduction

The maximum number of ICU admission are due to traumatic cases and rest are due to other medical and surgical conditions, most of these cases lead to physiological insult to the brain directing to impaired cerebral perfusion. GCS is one of the important indication of neurological functioning and brain perfusion and also important component of assessment. Thus maintenance of cerebral perfusion is an important area to be looked into among ICU patients (Marino, 2007).

The review established that low cerebral perfusion pressure is related to poor outcome among traumatic brain injury cases and optimizing cerebral perfusion is always advantageous as it help in physiological restoration of the brain environment and thus targeted to be in the range of 50-70 mmHg.

However the review also recommended targeted cerebral perfusion pressure therapy (White & Venkatesh, 2008).

## Research question and hypothesis

What is the cerebral perfusion pressure optimization practice in Neurosciences ICU?

## Background

Earlier the treatment of traumatic brain injury were targeted towards intracranial pressure (ICP) management, however this traditional techniques is challenged by the newer upcoming modalities of maintaining cerebral perfusion pressure (CPP). Thus the newer areas are directed at CPP maintenance targeted therapy. A literature review was done on cerebral perfusion pressure in a current guidelines and survey of clinical practice. Higher CPP threshold were not observed if blood pressure was calibrated at the heart level ( $p = 0.51$ ). The evidence behind the recommended CPP thresholds shows no consistency on how blood pressure is calibrated and clinical practice for MAP measurements and CPP target values seems to be highly variable. Hence, a consensus is reached on how to measure CPP (Rao & Klepstad, 2013). Thus the practice of cerebral perfusion pressure maintenance in ICUs is one of the necessary areas to be assessed. Hence the standard guideline for CPP maintenance needed to formulate based on best evidences that will in turn proves to be beneficial for patients as well as help to maintain uniformity among health personnel.

## Methodology

### Research design

A descriptive survey design was used in this study and it was conducted in Neurosciences ICU of Kasturba Hospital, Manipal on a population compromised of all the patients admitted in ICU of Kasturba Hospital, Manipal. The sample are patients admitted in selected ICUs and 29 patients were taken from Neurosciences ICU for assessing the practice of cerebral perfusion pressure maintenance during study period.

### Sampling criteria

- Traumatic Brain Injury patients or patients whose conditions are at risk of impaired brain perfusion.
- The checklist was followed to assess the measure CPP optimization practice.
- Single case at a time.

## Sampling technique

Non-probability purposive sampling technique was used to select sample with an attempt to cover the patients who were admitted to Intensive Care Units of Kasturba Hospital, Manipal.

## Data collection techniques

The data collection tools for the study were as follows:

Tool 1: Demographic and clinical proforma.

Tool 2: Cerebral perfusion pressure optimization checklist.

In the study the cerebral perfusion pressure optimization practice is assessed through checklist among the patients considering their diagnosis and covering those patients who have neurological insult. The reliability of the checklist was established by inter-rater reliability method with reliability coefficient,  $r=0.88$ .

This intervention practices in this study was measured in accordance with following areas:

- patient monitoring
- hydration and euolemia
- maintenance of ventilation
- osmotherapy
- anti-seizure measure
- sedation
- maintenance of normothermia
- positioning
- surgical management

Analysis was done with the help of SPSS 16. The data were analyzed by using descriptive statistics.

## Results

The characteristics of neurosciences patients under study were explained in the terms of specific clinical diagnosis. The detail is mentioned in Table 1 that shows that the majority 20 (68.97%) ICU admission in neurosciences falls under the diagnosis of craniocerebral injuries. The other common clinical scenarios found in neurosciences ICU were cerebrovascular disorders, intracranial neoplasms and neuroinfections. The cerebral perfusion pressure optimization practice was observed and the findings were tabulated in frequency and percentage under various heading. The details are mentioned in the following tables

**Table 1: Frequency and Percentage distribution of Neuroscience patients Clinical Diagnosis n=29**

Variables	Frequency	Percentage
	(f)	(%)
Cerebro vascular disorders	3	10.34
Cranio-cerebral injuries	20	68.97
Intracranial neoplasms	3	10.34
Neuroinfections	3	10.34

**Table 2: Frequency and Percentage distribution of cerebral perfusion pressure optimization practice for hemodynamic monitoring and maintenance n=29**

S. No.	Measures	Yes		No	
		(f)	%	(f)	%
<b>Monitoring</b>					
1.	Continuous ICP/CVP/ CPP monitoring			29	100
2.	Regular monitoring of vital signs	29	100		
3.	Routine assessment of GCS	29	100		
4.	Routine assessment of pupillary reaction and size	29	100		
<b>Hydration and euolemia maintenance</b>					
5.	Measure input output regularly	29	100		
6.	Provide calculated IV fluid	29	100		
7.	Maintenance of positive input-output balance.	28	96.55	1	3.45
8.	Maintenance of blood pressure	25	86.20	4	13.79
9.	Use of vasopressure agent	4	13.79	25	86.20
<b>Maintenance of ventilation</b>					
10.	Monitor oxygen saturation	29	100		
11.	Provide mechanical ventilation through endotrach tube	19	65.52	10	34.48
12.	Provide mechanical ventilation through tracheostc	3	10.34	26	89.65
13.	Provide face mask oxygenation	4	13.79	25	86.2

**Table 3: Frequency and percentage distribution of cerebral perfusion pressure optimization practice for medical therapy n=29**

S. No.	Measures	Yes		No	
		(f)	%	(f)	%
<b>Osmotherapy</b>					
1.	Use Inj. Mannitol 1-2 mg/kg body weight of 20% w solution.	22	75.86	7	24.13
2.	Consider hypertonic saline as a continuous infusio starting at 0.1 to 1.0 mL/kg/hr.			29	100
3.	Use Loop diuretics.	23	79.31	6	20.69
<b>Anti seizure measures</b>					
4.	Use Inj Phenytoin 15mg/kg body weight.	26	89.65	3	10.34
5.	Provide safer surrounding with side rails in bed.	29	100		
6.	Maintain minimal environmental stimuli around.			29	100
<b>Sedation</b>					
7.	Consider sedation as per requirement (Inj Midazolam 0.1 mg/kg/hr).			29	100
8.	Consider muscle relaxant ( Inj Atracurium 0.5 mg/kg/hr).			29	100
9.	Consider barbiturate therapy.	3	10.34	26	89.65
<b>Maintenance of normothermia</b>					
10.	Active maintenance of normal body temperature.	28	96.55	1	3.45

**Table 4: Frequency and Percentage of cerebral perfusion pressure optimization practice for surgical and other measures n=29**

S. No.	Measures	Yes		No	
		(f)	%	(f)	%
<b>Positioning</b>					
1.	Maintains head and neck neutral position.	24	82.76	5	17.24
2.	Exclude neck flexion.	27	93.20	2	6.89

3.	Maintain head elevation at 30 <sup>0</sup> unless contraindicated.	14	48.28	15	51.72
<b>Surgical management</b>					
4.	Consider extra ventricular drainage.	7	24.13	22	75.86
5.	Consider lumbar drainage.			29	100
6.	Consider shunt placement.			29	100
7.	Consider craniotomy.	15	51.72	14	48.28

The above findings showed that 100% monitoring of vital signs, GCS and pupillary reaction was done for neuro patients in ICU but cerebral pressure or intra cranial pressure was not monitored in any of them. For hemodynamic maintenance blood pressure was maintained among 86.20%, among which 13.79% was given vasopressure agent. The majority 65.75% were given mechanical ventilation through endotracheal tube.

Further practice was observed for medical therapies that were used for maintaining cerebral perfusion pressure in neurologically impaired patients in ICU. The detail is mentioned in the table 3.

The data presented in table 3 shows that for osmotherapy Inj mannitol was used among 75.86% and Inj lasix was used among 79.31% of neurologically impaired patients in Neuro ICU and hypertonic saline is still not practiced in this setup. Most of patient received Inj Phenytoin for anti seizure measures and side rails are used for all patients. No use of sedation and muscle relaxant was observed.

Further practice was observed for use of surgical measures that are used for maintaining cerebral perfusion pressure in neurologically impaired patients in ICU. The detail is mentioned in the table 4.

The data included in Table 4 shows that the positioning was maintained among most 82.76% of the patients. Among surgical management 24.13% was managed with extra ventricular drainage and 51.72 % underwent craniotomy.

## Discussion

The observation of cerebral perfusion maintenance practice revealed that there was 100% monitoring of vital signs, GCS and pupillary reaction. The blood pressure was maintained among 86.20% and 13.79% were given vasopressure agent. Majority 65.75% used mechanical ventilation through endotracheal tube. Inj mannitol was used among 75.86% and Inj lasix among 79.31% of patients in Neuro ICU for osmotherapy; hypertonic saline was not practiced. Most of patient received Inj Phenytoin for anti seizure measure whereas use of sedation and muscle relaxant was observed. A study was done on the efficacy of early treatment in severe traumatic brain injury shows the management line was like use of plasma expander for mean arterial pressure >90 mmHg and 76 patients received dopamine and 5 patients received noradrenaline for maintaining mean arterial pressure and cerebral perfusion pressure. Also mechanical ventilation was used for 157 patients. The propofol(2mg/kg) and midazolam(0.03 mg/kg/hr) was used for sedation 113 patients where as thiopentone and cistracuronium was used for 44 patients. Surgery was carried out for 57 patients. The study suggested that the early treatment of complications and maintenance of homeostasis leads to better prognosis in terms of survival, functional recovery and economy (Pace, 2006).

The present study shows that the positioning was maintained among most 82.76% A systematic review on effectiveness of backrest position on intracranial pressure (ICP) and cerebral perfusion

pressure (CPP) among patients with brain injury shows therapeutic positioning includes head elevation up to 30 degrees, correct and straight fixed head and neck alignment, regulated hip flexion, maintenance of CPP and other cerebrovascular parameters, decreases ICP. Thus head elevation up to 30 degrees is highly recommended as a therapeutic position for increase ICP patients (Fan, 2004).

Among surgical management 24.13% was managed with extra ventricular drainage and 51.72 % underwent craniotomy. A study was conducted among 379 pediatric patient shows that total 49 pediatric patients necessitate neurosurgical intervention and 7 of them met the criteria for a decompressive craniectomy. The result showed that all the surgical intervention patients had good outcome. Thus the study suggested that decompressive craniectomy is no longer a last measure to be followed but can be brought in first line management (Patel et al, 2013).

#### **Limitation**

- The CPP maintenance practice was assessed only for those who are at risk of CPP alteration as per their clinical diagnosis.
- The study findings cannot be generalized since practice may differ as per the critical care settings.

**Place of study:** Kasturba Hospital, Manipal University, Manipal Post Box No: 7, Manipal-576 104, Karnataka, India

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