

## A Prospective Study on the Outcome of Semi-Closed Neurointensive Care in A Tertiary Care Hospital Located in A Rural Area of Eastern Nepal: A Lower-Income Developing Country.

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**Background:** High mortality and morbidity in neurological patients are found due to lack of closed ICU (Intensive Care Unit), neurointensivist, and training in neurocritical care in most of the developing countries. Therefore, this study was conducted to evaluate the outcome of the neurological patient managed by neurointensivist in a semi-closed ICU. **Materials and methods:** It was a prospective, descriptive observational cross-sectional study in a level three Neuro-intensive care unit of a tertiary care hospital of Eastern Nepal, for one year in 191 patients. All patients above 18 years admitted to the Neuro-intensive care unit were included in this study. Demographic data was collected for all patients at the time of presentation to the ICU. The outcome of the patient was defined as transferred to Neuro-Ward, leave against medical advice (LAMA), do not resuscitate (DNR) and death. Statistical analysis was done by using SPSS. The result was presented as frequency and percentage. **Results:** Out of 191 patients, Males (71.7%) was more common than females (28.2%). There were 107 (56%) patients were admitted after 24 hours of injury or illness. 28.2% of patients had a hemorrhagic stroke and was the most common diagnosis for admission in the ICU. This study showed that 58(82.72%) patients survived and were discharged, 23(12%) expired, 7(3.66%) went in LAMA and 3(1.57%) gave do not resuscitate orders (DNR). Mean days on a mechanical ventilator was  $3.17 \pm 2.12$  days. Mortality in the intubated patient was 19%. **Conclusion:** A semi-closed Neuro-intensive care unit that includes full-time neurointensivist may have a better outcome than the open ICU.

**Key words:** Developing country, Intensive Care Units, Neurocritical care, Neurosurgery

Neurological diseases affect 276 million people worldwide, which constitute 11.6% of the global burden and cause 16.5% of global death.<sup>1</sup> There is a lack of data on the incidence of neurological disorder in Nepal but in other developing countries like India, Pakistan, and

Nigeria it ranges from 2.5-5%.<sup>2-4</sup> Life expectancy has increased in most of the developing countries and in Nepal it has increased by 12.16 years since 1990, reaching 70.64 years in 2013 for both sex.<sup>4</sup> High life expectancy has increased the number of older population which in turn has escalated the

people with neurological disorders in the world, which is also the same in Nepal and other developing countries.<sup>5-8</sup>

There is a lack of Intensive care unit (ICU) care in Nepal, and moreover there is more shortage of ICU beds in rural areas of Nepal. Data on the status of ICU across the country is also insufficient. However, a phone survey conducted in Kathmandu valley showed that there were roughly 480 ICU beds with 260 ventilators.<sup>9</sup> There has been no data available on the number of ICU which is closed, semi-closed, or open. However, most of them are open.

Neurological patients account for 30-40%<sup>10-14</sup> of total admissions in the ICU. Studies have shown that neurological patient managed by neurointensivist in a closed ICU has a better outcome.<sup>15-17</sup> Increasing requirement of the intensivist, lack of political commitment and public awareness has led to difficulty in establishing closed ICU in a developing country like Nepal. Semi-closed ICU managed by a full-time intensivist, neurosurgeon, neuro physician can be an alternative option. High mortality and morbidity in neurological patients are found due to lack of closed ICU, neurointensivist, and training in neurocritical care in most of the developing countries. Therefore, this study was conducted to evaluate the outcome of the neurological patient managed by neurointensivist in a semi-closed ICU.

### **Methods and Materials:**

**Study design and population:** We conducted a prospective, descriptive observational cross-sectional study in a level three Neuro-intensive care unit of tertiary care hospital of Eastern Nepal between Baishakh 1, 2076 to Chaitra 30, 2076. Ethical approval from the Institutional Review Committee was obtained before enrolment in this study. Written informed consent was obtained from the patients or surrogate decision-makers.

All patients above 18 years admitted to the neuro-intensive care unit were included in this study. Patients were excluded if they were younger than 18 years, surrogate decision-maker, or patient did not give written informed consent and were not having a neurological disease.

**Data collection:** Clinical data collected included Age, Sex, Occupation, Ethnicity, Acute Physiology, And Chronic Health Evaluation (APACHE) II, Sequential Organ Failure Assessment (SOFA) Score, Injury severity score, Diagnosis, Intubated or Non-intubated, Specialty, Sub-specialty, Co-morbidity, Time lag between injury or symptom and presentation to the ICU, mode of admission in ICU.

The outcome of the patient was defined as leave against medical advice (LAMA), do not resuscitate (DNR), death, and transferred to ward. The patient admitted to the neuro-intensive care unit who wishes to leave against the clinicians' advice was referred to as leave against medical advice (LAMA). Patients who were given all treatment except cardiopulmonary resuscitation and endotracheal intubation was referred as Do-not-resuscitate (DNR) but if signed after CPR and intubation, the patient was kept on ventilator support if the withdrawing of support was not requested. LAMA and DNR order were signed by the surrogate decision-maker after discussing it with the neurocritical care team. The reason for LAMA and DNR was recorded.

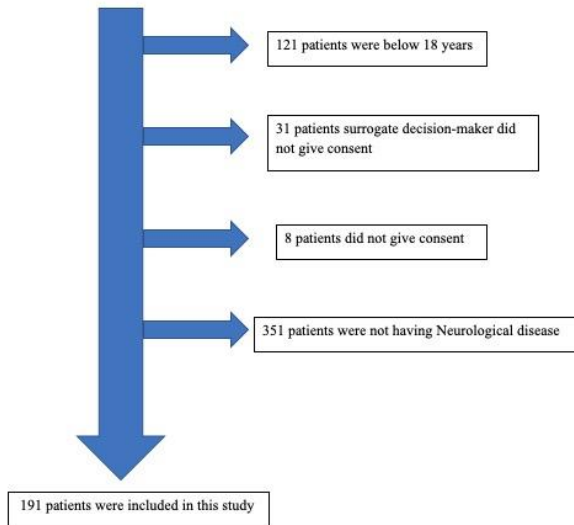
The following data was gathered before the patient was shifted to the ward from the neuro-intensive care unit or HDU: days on mechanical ventilation, length of stay in the intensive care unit.

The patient was followed in the ward until they were discharged, referred to another hospital or readmitted to neuro-intensive care unit, the reason for readmission and outcome of the readmitted patients was recorded.

**Statistical analysis:** Statistical analysis was performed using SPSS software (version 16.0; IBM, SPSS, Chicago, IL, USA). Values are presented as mean ( $\pm$  standard deviation SD) or frequency.

**Results:**

A total of 702 Patients were admitted to the ICU from 1<sup>st</sup> of Baishakh 2076 to 30<sup>th</sup> Chaitra 2076.



**Figure 1. Flow diagram of patients included in this study.**

Figure 1 shows that 191 patients were included in this study. The neurological disease accounts for 27.2% of total admission in the ICU in our study.

**Table 1. Demographic characteristics of the study population**

Parameters	n (%)
<b>Age (Years)</b>	
18-35	55(28.7)
36-60	82(42.9)
>60	54(28.2)
<b>Sex</b>	
Male	137(71.7)
Female	54(28.2)
<b>Ethnicity</b>	
Hindu	168(87.9)
Kirat	15(7.8)
Buddhist	5(2.6)
Muslim	2(1.0)
Christian	1(0.5)
<b>Occupation</b>	
Unemployed	64(33.5)
Farmer	52(27.2)
Housewife	22(11.5)
Student	21(10.9)
Labour	6(3.1)
Businessman	7(3.6)
Technical worker	15(7.8)
Army	4(2.0)

Table 1 shows the demographics characteristics of the study population. Middle-age patients were admitted more than younger and older age patients. 137(71.7%) were males and 54(28.2%) were females. Most of the patients in this study were Hindus and unemployed.

**Table 2: Clinical characteristics of the study population**

Parameters	n (%)
<b>Diagnosis</b>	
Non-Trauma	98(51.3)
Trauma	93(48.6)
<b>Injury severity score</b>	
<15	63(67.7)
>15	30(32.2)
<b>APACHE II Score at the time of admission</b>	
3-10	125(65.4)
11-20	56(29.3)
21-30	9(4.7)
31-40	1(0.5)
<b>SOFA Score at the time of admission</b>	
0-6	173(90.5)
7-12	15(7.8)
13-18	2(1.0)
19-24	1(0.5)
<b>Time of presentation to ICU (Hours)</b>	
<6	25(13.0)
6-12	23(12.0)
12-24	36(18.8)
>24	107(56.0)
<b>Mode of admission in ICU</b>	
Direct	37(19.3)
Refer	152(79.5)
Ward	2(1.0)
<b>Group of patient</b>	
Intubated	63(32.9)
Non-Intubated	128(67.0)

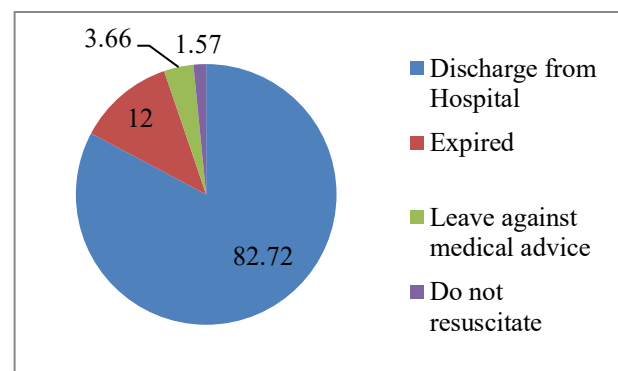
**APACHE II: Acute physiology and chronic health evaluation, ICU: Intensive care unit, SOFA: Sequential organ failure assessment.**

Table 2 shows the clinical characteristics of the study population. Non-trauma patients were more

common than trauma patients. There were 63% of trauma patients with injury severity score of less than 15. The majority of the patient at the time of admission had APACHE II of 3-10 and SOFA scores of 0-6. Most patients were admitted after 24 hours of injury or illness, referred from other hospitals and non-intubated.

This study showed that 159(83.24%) patients survived and were shifted to ward, 23(12%) expired, 6(3%) LAMA and 3(1.57%) DNR. One hundred fifty-nine patients survived and were shifted to the ward or high dependency unit.

Two (1.25%) patients got readmitted to the ICU. Neurological impairment was the most common reason for readmission in the ICU. Out of 2 patients, 1(50%) was shifted to a ward, and others went in LAMA.



**Figure 2: Outcome of patients from the hospital that were admitted to the intensive care unit.**

Figure 2 shows the outcome of patients from the hospital that was admitted to the neuro-intensive care unit.

Our study showed that 158(82.72%) patients survived and were discharged, 23(12%) expired, 7(3.66%) went in LAMA and 3(1.57%) gave DNR consent.

The mortality rate in our study was 23(12%). 14(60.8%) expired after 48 hours of ICU admission and 9(39.1%) within 48 hours of ICU admission.

Out of 191 patients, 63(32.9%) were intubated and required mechanical ventilation. The minimum days on a mechanical ventilator were 1 day and the maximum was 10 days. Mean days on a

mechanical ventilator was  $3.17 \pm 2.12$  days. Mortality in the intubated patient was 19%.

The minimum length of stay (LOS) for all groups of patients in the ICU was 1 day and the maximum was 29 days.

In our study poor prognosis and the high cost were the reason for LAMA in 5(71.4%) and 2(28.6%) patients respectively.

**Table 3. The outcome of patients according to sub-specialty**

Sub-specialty	Discharged n(%)	LAMA n(%)	DNR n(%)	Expired n(%)	Total n(%)
Neurology	31(59.6)	5(9.6)	2(3.8)	14(26.9)	52(100)
Neurosurgery	127(91.3)	2(1.4)	1(0.7)	9(6.4)	139(100)
	158(82.72%)	7(3.66%)	3(1.57%)	23(12)	191(100)

**DNR: Do Not Resuscitate, LAMA: Leave Against Medical Advice.**

Table 3 shows the outcome of patients according to sub-specialty.

**Table 4. The outcome of patients according to diagnosis**

Primary diagnosis	Discharged n(%)	LAMA n(%)	DNR n(%)	Expired n(%)	Total n(%)
Brain tumor	6(100)	0	0	0	6(100)
Cranioplasty	4(100)	0	0	0	4(100)
Diffuse axonal injury	8(100)	0	0	0	8(100)
Epidural hematoma	28(96.5)	1(3.4)	0	0	29(100)
Guillain barre syndrome	2(100)	0	0	0	2(100)
Hemorrhagic stroke	40(83.3)	1(2.0)	1(2.0)	6(12.5)	48(100)
Hypoxic brain injury	0	0	0	1(100)	1(100)
Ischemic stroke	18(64.2)	2(7.1)	1(3.5)	7(25.0)	28(100)

stroke					
Meningoencephalitis	2(22.2)	2(22.2)	1(11.1)	4(44.4)	9(100)
Neurocysticercosis	2(100)	0	0	0	2(100)
Subdural hematoma	20(86.9)	0	0	3(13.0)	23(100)
Seizure disorder	4(66.6)	1(16.6)	0	1(16.6)	6(100)
Skull bone fracture	9(100)	0	0	0	9(100)
Spinal cord injury	12(100)	0	0	0	12(100)
Tetanus	3(75.0)	0	0	1(25.0)	4(100)
Total	158(82.7)	7(3.6)	3(1.5)	23(12.0)	191(100)

Table 4 shows the outcome of patients according to diagnosis. Our study showed 28.2% of patients had a hemorrhagic stroke and was the most common diagnosis for admission in the ICU and 83.3% of patients were shifted to the ward. 100% of patients recovered from a brain tumor, cranioplasty, diffuse axonal injury, neurocysticercosis, skull bone fracture, and spinal cord injury.

Out of 191 patients, 93(48.6%) of patients had a traumatic brain injury (TBI). 87(93.5%) patients were shifted to ward, 4(4.3%) expired, 1(1%) LAMA, and 1(1%) gave DNR consent.

**Discussion:**

The incidence of neurological disease that required ICU admission in our study was 27.2% while in the other studies it varied from 30-40%.<sup>10-14</sup> The lower incidence in our study may be due to geographical variation and people from all communities may not afford a private hospital for treatment.

The present study showed that the incidence of neurosurgical and neurology patients that required ICU admission was 72.7% and 27.2% respectively.

Most of the neurosurgery patients present as emergency cases requiring immediate surgical interventions requiring ICU care, rendering to the high rate of such patients in our study.

The present study has shown that cerebrovascular disease was the most common reason for admission of patients in the ICU which is similar to other studies.<sup>18-20</sup> This may be because the cerebrovascular disease is an emergency requiring ICU care while other diseases may present as a non-emergency condition.

In present study, mortality was 12% while in other studies it varied from 4.5% to 10%.<sup>15-17</sup> The difference may be due to a lack of early resuscitation in rural areas before the transportation of patients to tertiary care.

Mortality in the intubated patients was 19% while in other studies varied from 25 to 40%.<sup>10-14,19-21</sup> This difference may be due to the co-management of patients by neurointensivist in our study.

The readmission rate in our study was 1.25% and 50% patient recovered and was transferred to ward while in other studies readmission was 10-12%.<sup>10-14</sup> Mortality in neurosurgical patients was 6.4% while in other studies it varied from 10.5-40%.<sup>11,19-21</sup> In present study, LAMA in neurosurgical patients was 1.4% while in a study by Acharya et al<sup>21</sup> it was 7.03%. In our study, DNR in neurosurgical patients was 0.7% while in a study by Acharya et al<sup>21</sup> it was 4.5%. This difference may be due to the early recognition of high-risk patients and early communication with family members. Mortality in TBI was 4.3% while in other studies it varied from 10.5% to 30%.<sup>19-22</sup> This difference may be due to early intervention by a neurosurgeon, the presence of neurointensivist, different geographical conditions, and a small group of trauma patients in our study. Male (71.7%) was more common than females (28.2%) in this study which is similar to other studies.<sup>10-14,19-21</sup>

The limitations of our study are primarily related to small sample size. Glasgow outcome scale was not recorded so long term of a patient was not known. Our results pertain to a single-center experience which limits generalizability.

## Conclusion:

12

A semi-closed ICU that includes full-time neurointensivist may have a better outcome than open ICU and can be a model in a developing country.

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