

Integration of Palliative Care in Neurosurgical Critical Care : Insights from a Single-Center Perspective

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Objective : Palliative care is a specialized approach designed to enhance the quality of life for both patients and their families, offering patient-centered care through comprehensive assessment and care planning. However, the integration of palliative care within neuro-critical care settings has been relatively understudied. This descriptive study aims to identify the characteristics, palliative care needs, and outcomes of patients referred to palliative care services during admission to the neurosurgical intensive care unit (NS-ICU).

Methods : A retrospective analysis of adults admitted to the NS-ICU at a referral hospital between December 2019 and December 2021 was conducted. The study focused on those referred to the inpatient palliative care team with diagnoses of non-traumatic brain hemorrhage, traumatic brain injury, or brain neoplasm. Excluded were patients who died before palliative care consultation or lacked sufficient information. The investigation assessed demographic and clinical characteristics at consultation, along with post-consultation hospital outcomes derived from medical records and interview notes.

Results : In this study involving 38 enrolled patients, the median age was 65, with 42.1% females. The most prevalent diagnosis was non-traumatic brain hemorrhage (47.4%). Reasons for palliative care consultation included psychosocial support (95%), goal-of-care discussions (68%), decision-making support (50%), and communication facilitation (39%). The median time from NS-ICU admission to consultation was 3.5 days (interquartile range, 1–8 days), and all interviews involved family members. Key decision topics encompassed mechanical ventilation (23.7%) and tracheostomy (21.1%). Patient preferences for life-sustaining treatment could be estimated in only 47.4% of cases, often resulting in treatment disagreement. Among the 38 patients, 26 (68.4%) died during admission. Before the consultation, full code status, partial code status, and comfort care alone were reported as 32%, 66%, and 2%, respectively; post-consultation, these figures shifted to 11%, 42%, and 47%, respectively.

Conclusion : Palliative care was predominantly sought for psychosocial support and discussions concerning goals of care. Despite challenges in ascertaining patient treatment preferences, palliative care consultations proved invaluable in aiding family members and facilitating treatment decision-making. Our study suggests the potential integration of palliative care within neuro-critical care, contributing to a heightened utilization of comfort care at the end-of-life.

Key Words : Critical care · Life support care · Palliative care · Patient-centered care · Life-sustaining treatment.

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INTRODUCTION

Neurocritical patients admitted to the neurosurgical intensive care unit (NS-ICU) often present with acutely debilitating neurological conditions, stemming from acute ischemic/hemorrhagic stroke, traumatic brain injury, or other non-traumatic brain injuries, such as highly aggressive brain neoplasms³⁵⁾. While comprehensive statistics on the epidemiology of neurocritical patients in South Korea are currently unavailable, the country is witnessing a surge in traumatic brain injuries^{9,32)} and vascular events^{1,14,19)} with the aging population, hinting at a potential rise in the demand for neurocritical care in the future. Concurrently, the socioeconomic burden associated with caring for neurocritical patients is gradually increasing^{5,20)}.

Critically ill neurosurgical patients exhibit distinctive features that set them apart from other seriously ill individuals^{11,12)}. Despite intensive treatment, they often face heightened mortality and clinical uncertainty, with outcomes varying significantly. The life-threatening nature of their condition may lead to early death²⁸⁾, especially post-decision to withdraw life-sustaining interventions, or substantial disability upon survival. Family caregivers, grappling with the patient's acute neurological changes, encounter challenges in surrogate decision-making and bear a substantial caregiving responsibility²⁵⁾. Even for those who survive, functional decline may persist. Therefore, there is an urgent need to enhance the quality of life for both neurocritical patients and their caregivers¹¹⁾.

Palliative care is a specialized approach designed to enhance the quality of life for both patients and their families through patient-centered care, involving comprehensive assessment and care planning³⁰⁾. The application of palliative care varies according to the illness trajectory. In progressive diseases such as cancer, the early integration of palliative care alongside disease treatment has been shown to substantially improve the quality of life for patients and their families. This integration also promotes the appropriate utilization of end-of-life medical care¹⁰⁾. However, the role of palliative care and its effective integration into the treatment of patients with an acute illness trajectory were not well-understood until the introduction of an initiative to enhance the quality of palliative care in ICUs in 2010³¹⁾. Since then, as part of the palliative care approach in the ICU, various interventions have been introduced, including decision-making support³⁾, family support^{4,36)}, and ethics consultation^{2,29)}. These efforts have resulted in positive outcomes, including a notable

reduction in distress experienced by ICU patients, their families, and healthcare professionals. Additionally, there has been an increase in patient and family satisfaction¹³⁾, coupled with a decrease in the overall length of ICU stay^{18,27)}. Also, recently, the concept of neuro-palliative care has been evolving, addressing the unique needs of patients with neurological conditions¹¹⁾. While recent research has highlighted the potential significance of facilitating goals of care discussions among those patients²⁸⁾, particularly those struggling to make independent decisions, the integration of palliative care in the NS-ICU remains undervalued.

In South Korea, as in other countries, patients with neurocritical conditions and their families may have significant palliative care needs. Despite the enforcement of the Act on hospice and palliative care and decisions on life-sustaining treatment (LST) for patients at the end of life (hereafter, LST Decisions Act) in 2018¹⁶⁾, hospice palliative services are inaccessible to neurocritical patients admitted to the NS-ICU although those with very limited prospects of recovery or who are brain-dead have been traditionally seen as candidates for end-of-life care. However, from the perspective of extending palliative care beyond end-of-life care to address "living well" rather than merely "dying well," some opinions suggest that neurosurgical ICU patients, who may face various challenges and needs even with successful treatment, could also be considered appropriate candidates for palliative care. This descriptive study aims to identify the characteristics, palliative care needs, and outcomes of patients referred to palliative care services during admission to the NS-ICU.

MATERIALS AND METHODS

The study protocol underwent review and received approval from the Institutional Review Board of at Seoul National University Hospital (SNUH) (No. H-2205-180-1331). Informed consent was waived following the protocol of the Institutional Review Board due to the retrospective design of the study.

Study design and objects

This retrospective study focused on adult patients admitted to the NS-ICU at a tertiary hospital in South Korea. Since 2018, a full-time neuro-intensivist has been stationed in the 12-bed NS-ICU at SNUH. On average, approximately 30 neuro-criti-

cally ill patients are admitted to this unit each year. The study specifically targeted adult patients referred to the inpatient palliative care team after admission to the NS-ICU, with primary diagnoses of non-traumatic brain hemorrhage, traumatic brain injury, or brain neoplasm. Excluded from the study were patients who died before meeting the palliative care team or those with insufficient medical records.

Inpatient palliative care consultation process

Lacking a dedicated hospice ward or home hospice, SNUH exclusively offers inpatient palliative care consultation services. The inpatient palliative care consultation team consists of two physicians, one specializing in palliative care, and a clinical fellow in internal medicine or family medicine. Additionally, the team includes one palliative care nurse and one medical social worker (0.5 full time equivalent). This team engages with the patient and their family, conducting interviews, performing comprehensive assessments, exploring and discussing care objectives, and providing guidance to healthcare professionals. When interviewing is not feasible due to the patient's condition in the NS-ICU, clinical evaluations are carried out, and family members are interviewed. The palliative care team particularly comes into play when a primary attending clinician (neuro-intensivist or neurosurgeon) initiates an on-demand palliative care referral based on the patient's palliative care needs.

Measurements

We collected comprehensive patient data, including socio-demographics (age and sex), clinical details (severity, neurological condition, diagnosis, and comorbidities), consultation-related characteristics, and post-consultation healthcare resource utilization from medical records and palliative care interview notes. Severity at ICU admission was assessed using the 12-point Sequential Organ Failure Assessment score, and the Glasgow coma scale (GCS) measured conditions at ICU entry, categorized as 8 or less, or 9 or more. Clinical diagnoses were classified as traumatic or non-traumatic, and by hemorrhage type (intracerebral, intraventricular, subarachnoid, or subdural). Comorbidities covered cancer, organ failure (chronic heart, pulmonary, liver, or renal), and neurodegenerative diseases. Prognostic evaluation scores determined in-hospital mortality and functional dependency, with specific measures for traumatic brain injury (FOUR score), subarachnoid hemorrhage (modified Fisher grading scale, Hunt & Hess score), and intra-

cerebral/intraventricular hemorrhage (Functional outcome score and intracerebral hemorrhage score).

The contents of palliative care consultations were extracted from interview notes, encompassing reasons for consultation, the number of interviews conducted, the number of participants interviews with the palliative care team, family's understanding of patient conditions, patient's and family's preferences for LSTs, medical procedures requiring discussion, and disagreements on treatment decisions.

To investigate the outcomes of palliative care consultations, we compared changes in code status before and after the consultation, length of hospital stays, mortality, and discharge location. The classification of code status included three categories : full code (indicating the implementation of all active measures), comfort care (focused on relief), and partial code (not requiring cardiopulmonary resuscitation but needing essential medical treatment). An investigation was conducted on the medical treatment received by patients who died at SNUH within 48 hours of their death.

Statistical analysis

Descriptive data were utilized to summarize the demographic and clinical characteristics of the patients, as well as the outcomes of palliative care consultations. For categorical variables, Pearson's chi-squared test or Fisher's exact test was applied. The comparison of code status proportions before and after palliative care consultation was conducted using McNemar-Bowker's test. Overall survival, defined as the time from the date of palliative care consultation to the date of death, was analyzed using Kaplan-Meier estimation. The log-rank test was employed to compare overall survival according to various variables. All statistical analyses were two-sided, with statistical significance set at $p < 0.05$. The analyses were conducted using STATA version 16.0 (StataCorp LP, College Station, TX, USA).

RESULTS

Patient characteristics

A total of 38 patients were enrolled between December 2019 and December 2021, and baseline characteristics are detailed in Table 1. The median age was 65 years (interquartile range [IQR], 45–73 years), with 57.9% being women. Of the 38 patients, 31.6% had traumatic etiology. The most prevalent clinical diag-

Table 1. Demographics and clinical characteristics of patients in neurosurgical intensive care unit who were referred to palliative care consultation (n=38)

Variable	Value
Age (years)	65 (45–73)
≥65 years	21 (55.3)
Sex	
Male	16 (42.1)
Female	22 (57.9)
SOFA score	
0–12	30 (78.9)
13–24	8 (21.1)
GCS on ICU admission	
9–15	13 (34.2)
≤8	25 (65.8)
Etiology	
Traumatic	12 (31.6)
Non-traumatic	26 (68.4)
Clinical diagnosis	
Intracerebral or intra-ventricular hemorrhage	9 (23.7)
Subarachnoid hemorrhage	11 (28.9)
Subdural hemorrhage	8 (21.1)
Brain neoplasm(s)	8 (21.1)
Other*	2 (5.2)
Comorbidities [†]	15 (39.5)
Cancer	13 (34.2)
Dementia or other neurodegenerative disease	3 (7.9)
Organ failure [‡]	6 (15.8)
Time from date of ICU admission to palliative care consultation (days)	3.5 (1–8)

Values are presented as median (interquartile range) or number (%).

*Other includes hypoxic ischemic injury after spinal cord injury (n=1) and dural arteriovenous fistula (n=1). [†]Duplicates are permitted. [‡]Organ failure includes advanced liver cirrhosis (n=5) and chronic lung disease (n=1). SOFA : Sequential Organ Failure Assessment, GCS : Glasgow coma scale, ICU : intensive care unit

nosis was subarachnoid hemorrhage, followed by intracerebral or intraventricular hemorrhage, subdural hemorrhage, and brain neoplasms. Approximately 40% of patients had significant comorbidities. The median time from admission to NS-ICU to palliative care consultation was 3.5 days (IQR, 1–8 days).

Process of palliative care consultation

Table 2 outlines the palliative care consultation process. The patient or family met with the palliative care team a median of

Table 2. Process of palliative care consultation and contents of interview (n=38)

Variable	Value
Time from referral to interview (days)	1 (0–2)
Number of interviews	
Once	31 (81.6)
Twice	7 (18.4)
Interview participant*	
Patient	3 (7.9)
Spouse	22 (57.9)
Offspring or offspring-in-law	27 (71.1)
Parent(s)	9 (23.7)
Other(s) [†]	8 (39.5)
Decisional options requiring discussion*	
Mechanical ventilation	9 (23.7)
Tracheostomy	8 (21.1)
Extra-ventricular drainage or ventriculoperitoneal shunt	5 (13.2)
Operation (including re-operation)	3 (7.9)
Cardiopulmonary resuscitation	2 (5.3)
Organ donation	2 (5.3)
Renal replacement therapy	1 (2.6)
Family perception of the patient's condition and prognosis	
Good understanding	28 (73.7)
Partial understanding or unrealistic expectation	6 (15.8)
Unidentified	4 (10.5)
Estimation of patient's preference for LST	
Yes	18 (47.3)
Withholding or withdrawal	17 (44.7)
Maintenance	1 (2.6)
No or unidentified	20 (52.6)
Family's preference for LST	
Withholding	16 (42.1)
Withdrawal	6 (15.8)
Maintenance	6 (15.8)
Indecision	7 (18.4)
Unidentified	3 (7.9)
Disagreement on treatment decision	
Yes	18 (47.4)
Between family members*	10 (26.3)
Between family and doctors*	10 (26.3)
No	20 (52.6)

Values are presented as median (interquartile range) or number (%). *Duplicates are permitted. [†]Other(s) refers to relatives of the second degree or higher. LST : life-sustaining treatment

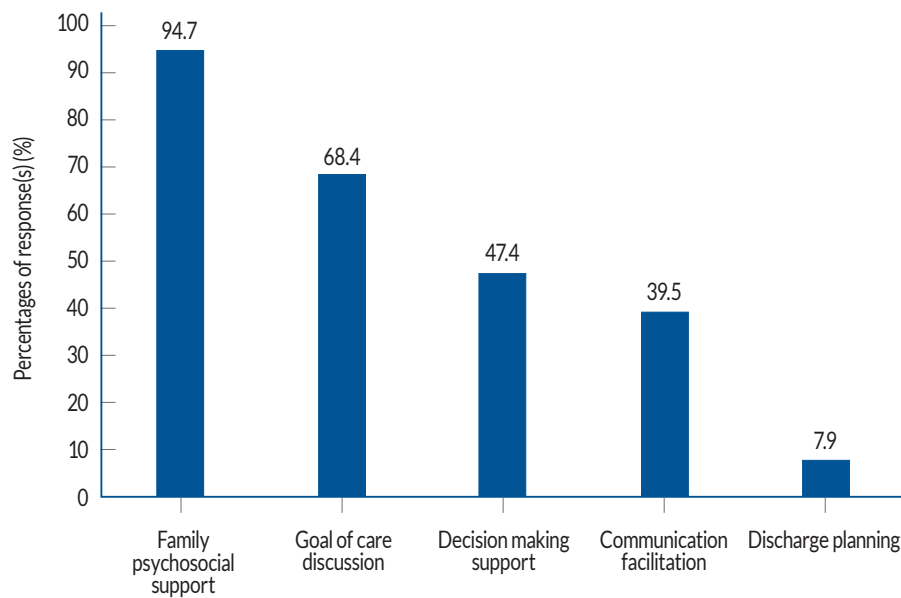


Fig. 1. Reasons for palliative care consultation in the neurosurgical intensive care unit. Duplicates permitted.

1 day after referral (IQR, 0–2 days). All interviews involved family members, and 7.9% of the patients themselves participated.

The predominant reasons for seeking palliative care consultation were family psychosocial support (94.7%), followed by goal-of-care discussions (68.4%), decision-making support (47.4%), and communication facilitation (39.5%) (Fig. 1).

Issues addressed during the interview with palliative care consultation team

Throughout the consultation process, the most frequently discussed options requiring decision-making were whether to administer MV (23.7%) and perform a tracheostomy (21.1%), as outlined in Table 2. Other topics included considering external ventricular drainage or a ventriculoperitoneal shunt (13.2%), as well as deciding to operate for brain lesions (7.9%).

Among family members, 73.7% demonstrated a good understanding of the patient's clinical condition and prognosis. The preference for LST could only be estimated for 47.4% of all patients, with the majority leaning towards a preference for withholding or withdrawal. Specifically, 42.1% of families expressed a desire to withhold LST, 15.8% wished to maintain the status quo, 15.8% wanted to withdraw LST, and 18.4% were undecided. Overall, there was disagreement about treatment in 47.4% of cases, with 26.3% experiencing internal family disagreement and an additional 26.3% facing disagreement between the fam-

Table 3. Outcome of patients who were referred to palliative care consultation (n=38)

Variable	Value
Length of hospital stay (days)	
Neurosurgical ICU	12.5 (5–20)
Overall hospital	14 (6–32)
Location of discharge at index admission	
Death	26 (68.4)
Home	1 (2.6)
Other hospital	11 (29.0)

Values are presented as median (interquartile range) or number (%). ICU : intensive care unit

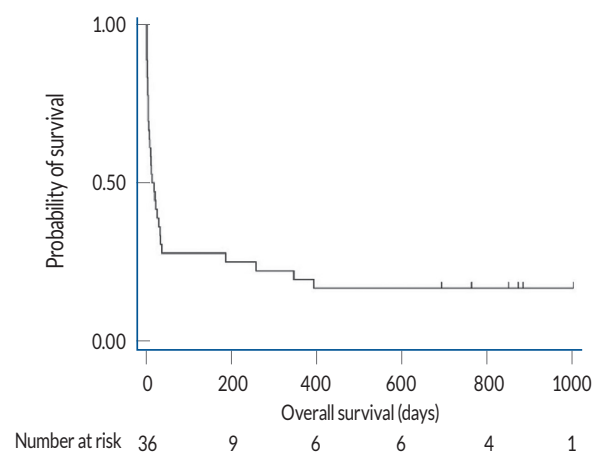


Fig. 2. Overall survival of 38 patients referred to palliative care consultation.

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Outcomes after palliative care consultation

Among the 38 patients referred to palliative care, the median length of stay in the NS-ICU was 12.5 days, with an IQR of 5 to 20 days. The overall median length of stay for these patients was 14 days, with an IQR of 6 to 32 days. During hospitalization, 26 patients died, and 11 were transferred to another hospi-

tal, except for one patient who was discharged home (Table 3). Over a median follow-up period of 179 days (ranging from 0 to 1260 days), mortality occurred in 84.2% of the patients (32 patients), with 27 in-hospital deaths. Out of the total, 70.4% of deaths (19 out of 27) occurred in the NS-ICU. The median overall survival was 13 days (95% confidence interval, 5 to 32 days) (Fig. 2).

Before the palliative care consultation, full code status, partial code status, and comfort care alone were reported as 32%, 66%, and 2%, respectively; after consultation, these figures shifted to 11%, 42%, and 47%, respectively (Fig. 3). This change was statistically significant ($p < 0.001$).

Fig. 4 provides an assessment of the medical treatment and medication administered to 27 individuals who died at our institute within 48 hours of their death. All patients underwent MV, with 14 patients (51.9%) choosing to withdraw ventilator use. Imaging and blood tests were performed until the day before death for 77.8% and 74.1% of patients, respectively. Only 40% of patients received comfort care.

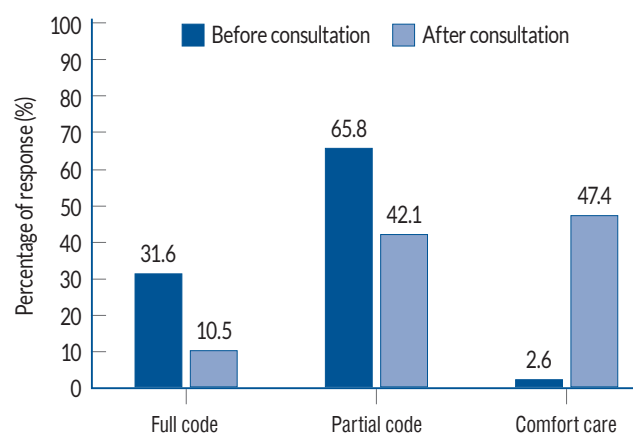


Fig. 3. Change in code status before and after palliative care consultation.

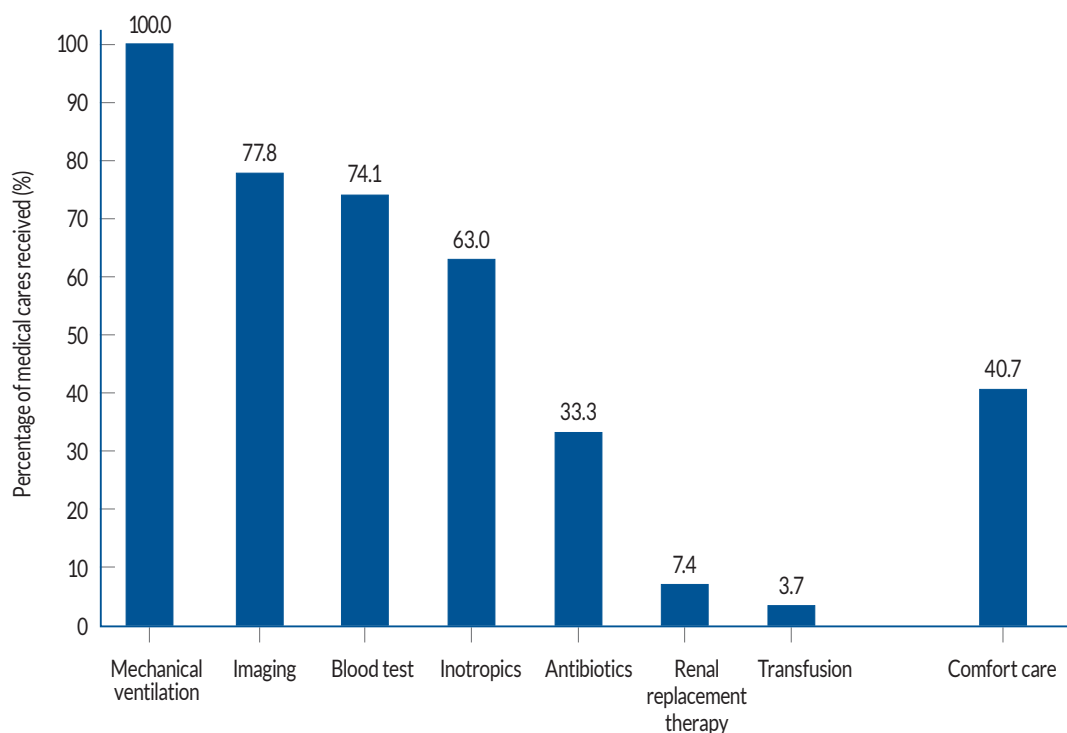


Fig. 4. Medical care in the last 48 hours before death for patients deceased in the institution (n=27). Duplicates permitted.

DISCUSSION

This study underscores the diverse palliative care needs among NS-ICU patients who received palliative care consultation, with a significant emphasis on decision-making. Furthermore, the research reveals a noteworthy finding: a shift towards comfort-oriented code status following palliative care consultation. Importantly, our study illuminates the trajectory of palliative care for neurosurgical patients and their families, a group often overlooked but needing palliative care alongside intensive care as comprehensive approaches.

Our study shows that the primary reason doctors referred patients to palliative care was for family psychosocial support, aligning with trends seen in similar ICUs abroad³⁴. Internationally, a neuro-ICU study revealed that 62% of patients and their families had palliative care needs, with 53% requiring social support⁷. Particularly regarding anxiety and depression, several prospective studies revealed that the prevalence of moderate to severe mood symptoms was identified in 36.4% to 54.5% of family members of patients with severe acute brain injury^{6,24,25}. Some studies additionally reported that caregivers are at a greater risk for post-traumatic stress and burden^{8,24}. Our study suggests that doctors identified the needs of family caregivers during discussions of treatment plans as most patients were not able to communicate, resulting in a high prevalence of family support as the referral cause.

In alignment with previous research on palliative care needs for critically ill patients²⁷, our study identifies goals of care conversations and decision-making support as major reasons for referral. Ensuring goal-concordant care for patients and their families is of utmost importance in patient-centered care, a principle that extends to patient care in the NS-ICU. However, as our research demonstrates, only around half of the cases allow for the estimation of patient values and preferences. Making decisions on behalf of NS-ICU patients' families is, therefore, challenging in such situations²⁸. Ethical principles guiding surrogate decision-making say that the tendency to omit determining or estimating the patient's previous wishes and to rely solely on the surrogate's opinion should be avoided²¹. In our study, tracheostomy, often chosen in approximately 30% of patients with severe acute brain injury¹⁷, and MV were the main options that required discussion. According to a qualitative study reflecting on tracheostomy decisions in family members of patients with severe acute brain injury²², meeting a funda-

mental need for supportive, consistent communication centered around compassion, clarity, and hope would help family members make surrogate decisions regardless of the eventual outcomes. The role of palliative care in the context of decision-making support is not necessarily to encourage a transition to comfort care but to support the surrogate decision-makers by facilitating discussions centered on the patient, thereby guiding the surrogate decision-making process and reconciling disagreements¹¹.

Our study reveals an anticipated shift towards favoring comfort care both before and after palliative care consultation, consistent with findings from research where palliative care was administered in the ICU^{3,13,26,33}, showing higher rates of Do-Not-Resuscitate orders and a preference for comfort care. This observed association may be due to the process in which palliative care helps clarify the patient's understanding of their disease state, explores preferences for patient-centered decision-making, and prompts consideration of goals of care. This process often leads family members to develop a more realistic understanding of the disease and make more informed decisions about LSTs. The integration of early palliative care in ICUs is predicted to reduce the length of hospital stay and costs by minimizing non-beneficial aggressive interventions for patients on LST, based on international experiences^{15,18,26,36,37}. However, in Korea, changes in code status may not directly indicate the withholding or withdrawal of LST due to the 2018 LST Decisions Act. The Act allows LST only for patients in the dying process, posing challenges in determining the dying process for neurocritical patients not brain dead. Further research is needed to understand how changes in code status align with the LST Decision Act.

In our study, 84.2% of patients referred to palliative care ultimately died, while the survivors necessitated long-term care. MV was administered to all patients and functioned as an LST, with the consideration of withdrawal¹². The decision to discontinue MV in these cases involves ethical considerations for healthcare professionals¹¹. Should the decision be made to stop MV, it is essential to provide support for the emotional needs of the family. Notably, our study reveals that 40% of patients referred to palliative care received comfort treatment. The adequacy of such treatment may be compromised when end-of-life symptoms in neuro-critical patients are underestimated, as they may not manifest distressing symptoms themselves. However, a significant level of distressing signs was reported to be

observed at the end-of-life³⁸⁾. It is suggested that palliative care can contribute to appropriate end-of-life care in such circumstances³³⁾.

The findings of our study offer insights to the ongoing discourse concerning the implementation of palliative care for patients in the NS-ICU in South Korea. From a clinical standpoint, further deliberation is imperative regarding the optimal criteria for administering palliative care. Existing literature suggests traumatic brain injury with a poor neurological prognosis, extensive intracranial hemorrhage/subarachnoid hemorrhage with no surgical interventions, hypoxic ischemic encephalopathy, low presenting GCS (<8 for >1 week or Glasgow outcome score <3), or two or more multisystem organ failure as triggers for palliative care referral^{23,26)}. However, recognizing potential variations attributable to distinct national and cultural contexts, it becomes essential to propose indicators tailored to national circumstances. Institutionally, the study underscores a noteworthy incongruity where existing policies do not align with the paradigm shift towards the early integration of palliative care within disease-centered treatment. Additionally, access to hospice services for patients in the NS-ICU in South Korea is restricted, except for cases involving malignant brain neoplasms. The implementation of palliative care may require the establishment of a pertinent system to address these unique challenges.

This study's limitations stem from its focus on a single tertiary care center with a small subject pool, limiting the generalizability of findings. Palliative care consultation was formally integrated into the Korean healthcare system following the implementation of the LST Decision Act in 2018, which limited our data collection to that year onward. Given that palliative care consultation in the NS-ICU is still in its early stages, conducting a multicenter study to increase case numbers was not feasible. The limited number of patients admitted to the NS-ICU in this setting also made it unavoidable for our study to be a small-scale descriptive study. However, within the context of limited palliative care for critically ill neurosurgical patients in South Korea, the study holds significance. Second, the absence of a control group hinders the ability to compare and assess the unique impact of palliative care. Unfortunately, as a control group, we would have needed to select patients who did not receive palliative care among those using the NS-ICU within a relatively short period, which predominantly serves patients undergoing scheduled surgeries requiring post-operative ICU

care. These patients did not fit our inclusion criteria, making it impossible to find an appropriate control group. Future research should prioritize prospective comparative studies to clarify the effectiveness of such interventions. Additionally, the retrospective nature of the analysis prevents an exploration of subjective improvements in the quality of life or care perceived by patients or their families in response to palliative care. Since the primary goal of palliative care is to enhance the quality of life for patients and their families, assessing patient (or family)-reported outcomes is indeed necessary to demonstrate the effectiveness of palliative care. Although our study, being a retrospective analysis, had limitations in systematically evaluating such outcomes, it will be crucial for future prospective studies to include outcomes such as quality of life, decision-making conflicts, and mood to assess effectiveness.

CONCLUSION

In conclusion, for patients in an NS-ICU, palliative care was mostly consulted for psychosocial support and goals-of-care discussion. Despite the difficulties in estimating the patient's treatment preference, palliative care consultation supported family members and facilitated treatment decision-making. According to our study, palliative care was well integrated into clinical practice in neuro-critical care, resulting in more comfort care at the end-of-life.

AUTHORS' DECLARATION

Conflicts of interest

No potential conflict of interest relevant to this article was reported.

Informed consent

This type of study does not require informed consent.

Author contributions

Conceptualization : HYP, EJH, SHY; Data curation : NHK, YK, SHY; Formal analysis : NHK, YK, SHY; Funding acquisition : EJH, SHY; Methodology : YK, SHY; Project administration : EJH, SHY; Visualization : NHK, YK, SHY; Writing - original draft : NHK, YK; Writing - review & editing : SYK, HSH,

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Data sharing

None

Preprint

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