Collaborative Integration of Palliative Care in Critically Ill Stroke Patients in the Neurocritical Care Unit: A Single Center Pilot Study

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Introduction: Patients admitted to the Neurocritical Care Unit (NCCU) with moderate-to-severe acute strokes, along with their surrogate decision makers, have the potential for unrecognized or unmet emotional and psychological needs. Our primary objective was to determine if early integration of palliative care consultations within this cohort was feasible and would impact understanding, decision-making and emotional support to patients and their surrogate decision makers. Our secondary objective was to evaluate the long-term impact of early palliative care assessment on the development of post-traumatic stress disorder (PTSD). *Methods:* This was a single center prospective pilot study. Patients with moderate-to-severe ischemic and hemorrhagic strokes were randomized into two arms. The control arm received standard intensive care and the intervention arm received an additional early palliative care consultation within 72 hours of hospitalization. Study assessments with the participants were obtained on day 1-3, and day 5-7 of care with comparisons of total scores on the Questionnaire on Communication (QOC), Decisional Conflict Scale (DCS), and Hospital Anxiety and Depression Scale (HADS). Furthermore, comparisons of HADS and PTSD DSM-5 (PCL- 5) scores were completed at 3 months. Linear mixed effects models were conducted to examine the association between intervention and participant's scores. *Results:* A total of 22 participants were enrolled between February 2019 and April 2020. Statistically significant improvement in scores was seen in the total HADS score (p=0.043) and PCL5 score (p=0.033) at 3 months following intervention. *Conclusion:* Collaboration between the intensive care and palliative care team with early palliative assessment may be beneficial in lowering anxiety, depression and PTSD symptoms in critically ill stroke patients and their caregivers. Further research is needed to validate these findings.

Key Words: Palliative medicine—Palliative care—Cerebrovascular accident—Acute stroke—Intensive care unit

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Introduction

Patients admitted to the Neurocritical Care Unit (NCCU) may have the potential for unmet palliative care needs given medical complexity, communication barriers directly with patients, and prognostic uncertainty coupled with the acute and sometimes devastating debility of the disease[1]. Data shows that palliative needs may be present in up to 62% of patients admitted to the NCCU, with large ischemic strokes or intracerebral hemorrhage requiring mechanical ventilation being most common and particularly vulnerable.[2-5] However, data from the National Inpatient Sample that included 395,411 stroke patients, reported palliative care encounters in only 6.2% of patients.[6] Furthermore, both patients admitted to an Intensive Care Unit (ICU) and their family members may suffer from new or worsening physical, cognitive or mental health distress, beyond the acute hospitalization phase known as "Post-intensive care syndrome" or "Post-intensive care syndrome-family".[7-8]

Thus, in recent years, palliative care collaboration with the intensive care teams has become integrated into practice for high-quality, comprehensive care across many intensive care settings. Specific triggers for palliative consultations reported in the literature within this population include intracerebral hemorrhage, mechanical ventilation, clarifying goals of care, family support, decision making, discharge planning and communication.[4,9-10] Proactive multi-disciplinary measures have shown to improve communication, patient and family centeredness of care, reduced the length of ICU stay, completion of advanced care planning, and overall quality of care in patients with various devastating illnesses.[11-18]

The overarching goal of palliative care medicine is to focus on goal concordant care, which can further be defined as concentrating on patient centered care, whether that be, curative, rehabilitative, or for comfort. This includes managing physical and psychological symptoms; addressing spiritual, social and cultural needs; improving understanding of disease process; and/or end-of-life discussions.[19] Integrating early palliative care assessments into patient care can improve a patient's social support, communication, advance care planning, and satisfaction of the patients and their surrogates with overall quality of life.[11-12, 20-21]

Our primary objective was to determine if early collaborative care within the NCCU with integration of palliative care consultations was feasible and if it improved understanding, decision-making and emotional support to patients and surrogate decision makers in critically ill stroke patients. Our secondary objective was to evaluate the impact of palliative care support on the development of post-traumatic stress disorder amongst either patients or their surrogate decision makers.

Methods

This was a prospective study approved by the IRB at our comprehensive stroke center. Patients were recruited and enrolled from February 2019 − January 2020, with final follow up completed in April 2020. The NCCU is a 24-bed closed unit that provides specialized care to critically ill neurosurgical, neurological, and post-operative patients.

Study population

Inclusion and exclusion criteria

All patients admitted to the NCCU with moderate to severe ischemic or hemorrhagic stroke were screened for potential inclusion, regardless of intubation status. Moderate to severe ischemic or hemorrhagic stroke was defined as a patient with a Modified Rankin Score (mRS) of 3 or above at time of presentation (on a scale of 0 − 6, where 0 has no symptoms, 3 is *"Moderate disability. Requires some help, but able to walk unassisted"*, and 6 is death), and an NIHSS of 10 or greater. We utilized data extrapolated from the landmark TOAST clinical trial[22] to best understand what NIHSS would be consistent with a moderate to severe stroke with disability. Based on this landmark paper, an NIHSS of 16 or greater indicated a strong probability of patient death, while a baseline NIHSS of less than 6 indicated a strong probability of good recovery. Thus, a rounded median between these two values, or a value of 10, was chosen to indicate a moderate to severe disability. The mRS is a validated measure of physical disability, standardly used to assess and evaluate patient's outcomes after stroke.[23] NIHSS was superseded by mRS as an inclusion criterion, as it elucidated the importance of requiring assistance and overall mobility. Furthermore, patients with premorbid baseline deficits of mRS > 2 were excluded from our study and mRS was calculated using the stroke severity on presentation.

Patients and caregivers were approached for study enrollment based on the following criteria: age 18 years and above, anticipated admission to the NCCU for greater than 48 hours, NIHSS ≥ 10, mRS ≥ 3, and an identifiable surrogate decision maker or legal next of kin with the ability to speak English and consent to participate in the study. Patients were excluded from consideration if they were pregnant, incarcerated, presented with subarachnoid hemorrhage, transitioned to comfort care within 48 hours of admission, admitted to the NCCU after a planned neurosurgical procedure, or lacked an identifiable surrogate decision maker or legal next of kin with the ability to speak English and consent to participate in a timely manner.

At the time of screening, patients had already been admitted to the NCCU, and thus, most acute emergent ischemic stroke interventions, including administration of

intravenous tissue plasminogen activator (tPA) and mechanical thrombectomy (MT) were already completed. However, if a patient was admitted with a hemorrhagic stroke, an extraventricular drain (EVD) placement, and/or hemicrianiectomy (HC) may or may not have been done depending on the patient's clinical presentation.

Participant characteristics

Participants include patients and their surrogate decision makers. Demographic information included: age, gender, ethnicity, educational status, marital status, and employment status. Clinical data included: patient baseline comorbidities, stroke type (hemorrhagic, ischemic, ischemic with hemorrhagic conversion), degree of stroke severity on admission and discharge based on mRS and National Institute of Stroke Scale (NIHSS), code status on admission and discharge, length of NCCU stay, length of total hospital stay, and discharge disposition.

Randomization

Once participants were screened and met inclusion and exclusion criteria, they were approached for study enrollment and informed consent. Once consented, they were randomized into either control or intervention arms. Randomization was done en block to allow for equal distribution in both groups and included patients treated by various care providers. Allocation of participants was equally distributed into control and intervention arms with an allocation ratio of 1:1.

Intervention and Control Arms

In both groups, routine management of ischemic or hemorrhagic strokes, mechanical ventilation, and systemic complications, was performed based on the standard of care defined by the American Stroke Association Guidelines.[24] This included all acute or emergent interventions approved by the Federal Drug Administration for ischemic and hemorrhagic stroke including the administration of tPA, MT, EVD placement, and/or HC if indicated. In the control arm, the patient received routine NCCU care with palliative care consultation placed per the discretion of the treating team. In the intervention arm, the patient received early palliative care consultation. This consisted of two meetings, the first occurred within 72 hours of admission to the NCCU, and the second one was conducted at, at least, 5-7 days after admission, or prior to discharge.

Prior to all palliative interventions, the primary NCCU team had a collaborative and comprehensive discussion with the palliative care team focusing particularly on the understanding of where the patient was in the spectrum of the natural history of disease, and the presence or lack of prognostic indicators at that particular time. During the palliative care consultation, a member of the palliative team assessed the participants and surrogate decision makers palliative care needs using the eight domains of palliative care. Specific emphasis was placed on patient and/or surrogate decision maker's understanding of disease process, prognostic awareness, and elements of shared decision-making in collaboration with the NCCU team. The majority of palliative care consultation meetings were conducted with a member of the NCCU team; however, if the team was not present, they were notified of the salient points of the discussion and if any preferences away from the current care were voiced (for example, the participant wanted to have end of life discussions, change in code status or elected to shift to comfort measures). If these preferences were identified, further conversations were done with the surrogate decision maker together with both the primary NCCU team and the consultant palliative team.

Study instruments & outcomes

Study outcomes were assessed through validated surveys given to both groups of participants during the following three-time frames:

1) Time 1: Day 1-3 of admission to the NCCU and if within the intervention arm, prior to the palliative care encounter (in-person),
2) Time 2: Day 5-7 of hospital care or prior to discharge,
3) Time 3: At 3-months post-discharge (phone-call) (Table 2).

At time point one and two, three surveys were distributed to participants: Questionnaire on Communication (QoC), Decisional Conflict Scale (DCS), and Hospital Anxiety and Depression Scale (HADS). Finally, at time point three, participants were asked to complete the Hospital Anxiety and Depression Scale (HADS) and Post Traumatic Stress Disorder Checklist for DSM-5 (PCL- 5). Surveys were filled by the surrogate decision maker alone, or in conjunction with the patient based on their ability to participate.

Questionnaire on Communication (QoC)

The Quality of Communication questionnaire is a seventeen-item survey developed from qualitative studies with patients, families and clinicians, in which thirteen items measured two components of communication: general communication (six items) and communication about goals of care (seven items). Items are scored from $0 - 10$, with higher scores indicating better communication.[25]

Decisional conflict scale (DCS)

The Decisional Conflict Scale is a sixteen-point instrument, measuring individual's perceptions of uncertainty

in choosing options and modifiable factors contributing to uncertainty, such as feeling uninformed, unclear about personal values, and unsupported decision-making.[26] Higher scores indicated higher decisional conflict.

Hospital Anxiety and Depression Scale (HADS)

The Hospital Anxiety and Depression Scale is a fourteen-item assessment with subscales of anxiety and depression that have been validated and reliable amongst surrogates and other trials of behavioral interventions.[27-28] Each domain has a score range of 0−21; 0−7 = normal; 8−10= borderline abnormal; 11−21 = abnormal, with higher scores indicating higher levels of anxiety and depression. This was measured at three different time frames (twice during hospitalization and once during the 3 month follow up phone survey) to determine, the changes with our intervention. HADS values at 1 week have correlated with symptoms of Post-Traumatic Stress Disorder 3 months following ICU stay.[29]

Post-traumatic stress disorder checklist for DSM-5 (PCL- 5)

The symptoms of PTSD were assessed using the Post Traumatic Stress Disorder Checklist for DSM-5 by a telephone survey at 3 months post-discharge, i.e., 3 months after the inciting event.[30] The PCL-5 is a 20-item self-report measure that assesses 20 symptoms of PTSD and is used for screening individuals for PTSD.

Statistical methods

Descriptive statistics were conducted to describe the characteristics and scores of the patient sample overall and stratified by intervention. Comparisons between groups were performed using two sample t-tests for normally-distributed continuous variables and Mann−Whitney U-tests for non-normally-distributed continuous variables, as well as Fisher's exact test for categorical variables with small sample sizes. Results were reported as mean and standard deviation and median and interquartile range when appropriate.

Linear mixed effects models were conducted to examine the association between intervention and patients' or surrogate decision maker's scores at different time points. Individual patients were entered as a random effects term. The models were fit via maximum likelihood estimation using the lme function from the nlme package in R (v3.4.1, R Foundation, Vienna, Austria) and R Studio (v1.0.153, RStudio Inc., Boston, MA). For all analyses, p-values <0.05 were considered statistically significant. We decided a priori to conduct four separate models for each of the four scales and include intervention, timepoint if present, and score in each baseline model. We explored the interaction between intervention and timepoint when appropriate (e.g., only for QoC, DCS, and HADS scores). Other variables were added to the model if they had a p value <0.20 for the relationship between the variable and score in a baseline model that also included the intervention and timepoint.

We chose not to attempt to perform multivariable modeling using forward and backward selections methods and did not adjust for multiple comparisons using Holm−Bonferroni method due to the inherent limited sample size and degrees of freedom available in this hypothesis-generating study.

Results

Participant baseline characteristics

Of the 431 patients initially screened from 2/4/2019 − 1/5/2020, 106 met initial screening criteria of moderate to severe ischemic or hemorrhagic stroke admitted to the NCCU. Of these 78 were excluded: 41 did not have an identifiable surrogate decision maker available to consent or actively participate in the study, 30 declined participation, 6 were participating in another trial which did not allow for multiple study enrollments, and 1 was excluded based on attending preference; leaving 28 consented and enrolled participants. Of the 28 participants, 22 completed the study, and 6 were removed from analysis due to inability to complete pre/post surveys (Fig. 1). Of the 22 participants who completed the study, 11 patients were randomized to each arm. Of the 11 patients within the control arm, none received palliative consultation.

Participant characteristics are outlined in Table 1. The majority of all survey responders (n=21/22, 95.45%) within both the control and intervention arms were surrogate decision makers. Only one patient participated in the surveys conducted at 3-month follow up alongside their surrogate decision maker who had previously filled out surveys during the patient's hospitalization. The majority of patients were Caucasian (81.82%), experienced an ischemic stroke (59.09%), and had surrogates who had completed at least some college (71.43%). The average patient age was 62.73 (± 14.93) and an average NIHSS score at admission was 16.18 (Standard Deviation = 7.63). There were no significant differences in patient characteristics between the two groups (Table 1). Similarly, baseline characteristics of enrolled surrogate decision makers were largely similar except for a statistically significant difference between the education status of the surrogate decision maker, with a higher percentage of advanced degree in the intervention arm (p=0.009). (Table 1).

Amongst both groups, eight patients in each arm presented with ischemic strokes, with one each complicated by hemorrhagic conversion; and three with primary intraparenchymal hemorrhage (IPH). Location of stroke, stroke mechanism, and acute stroke interventions that were performed are outlined in Table 4. Stroke

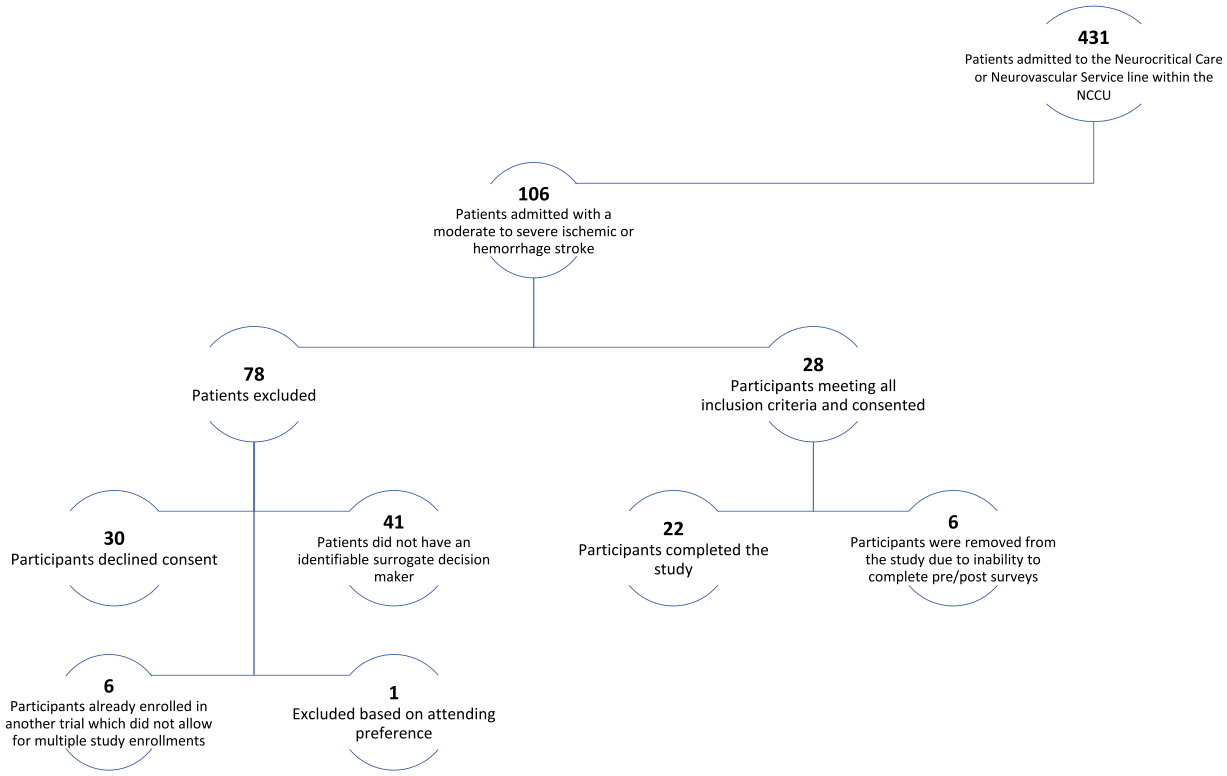

Fig. 1. *Participant Screening and Randomization Procedure.*

interventions performed included: Intravenous tPA, MT, EVD placement, and/or HC if indicated.

Comparison between total survey scores across different time points

Survey data across different time points is outlined in Table 2. There were no significant differences in the QoC and DCS scores between the groups and across timepoints (Tables 3). There were, however, significant differences in the total HADS scores (p=0.043), the anxiety subcomponent of the HADS score (p=0.016) and the PCL-5 scores (p=0.033) (Table 3). There were both marginal and statistically significant interactions between intervention and various timepoints for HADS scores (p=0.06 and p=0.028) (Table 3). Additionally, there was statistically significant difference in the PCL5-3 scores between intervention arm and control arm groups at 3 months (p=0.018) (Table 3), suggesting that early palliative care assessment may lead to a decrease in anxiety, depression and post-traumatic stress experience at three months.

Patient discharge disposition and mortality

There was no statistical difference between discharge disposition or mortality between both groups. Four patients were discharged to inpatient rehab (IPR) in the control group, as compared to the two in the intervention arm. Six patients were discharged to skilled nursing facility (SNF) in the control group as compared to the five in the intervention. Both these findings were not significant.

Discussion

Our study aim was to determine the feasibility of integrating a palliative care assessment earlier in the hospital course to improve communication and goal concordant care. We aimed to characterize the impact of this intervention on patient and surrogate decision maker outcomes such as quality of communication, decision-making, anxiety and depression, and PTSD) using validated tools. Our unadjusted data for total 3-month PCL5 score in patients and surrogates who received palliative care intervention was significantly lower compared to standard care. When compared to the standard of care group, patients receiving palliative care reported scores corresponding to less anxiety and depression at three months relative to baseline and immediately after palliative care consultation. These data indicate that palliative care integration may have a long-term benefit in critically ill stroke patients in terms of anxiety, depression, and PTSD.

Furthermore, our study did not reveal a statistically significant effect on mortality rate when comparing both arms, a salient concern of many providers being cognizant of avoiding self-fulfilling prophecies (SFPs) and premature withdrawal of care. This is especially of concern within the NCCU, where biomarkers of prognostication

Table 1. *Characteristics of patients and surrogates.*

Characteristic	Overall (n = 22)	Routine care (n = 11)	Palliative care (n = 11)	p-value
Patient age Median [IQR]	65.50 [56.75, 70.00]	61.00 [49.50, 68.50]	67.00 [61.50, 75.00]	0.157
Patient sex, n (%)				1.000
Male	12 (54.55)	6 (54.55)	6 (54.55)	
Female	10 (45.45)	5 (45.45)	5 (45.45)	
Patient race, n (%)				0.580
Caucasian	18 (81.82)	10 (90.91)	8 (72.73)	
African American	4 (18.18)	1 (9.09)	3 (27.27)	
Stroke type, n (%)				0.158
Hemorrhagic	6 (27.27)	3 (27.27)	3 (27.27)	
Ischemic	13 (59.09)	8 (72.73)	5 (45.45)	
Ischemic with hemorrhagic conversion	3 (13.64)	0 (0.00)	3 (27.27)	
Patient change code status at admission, n (%)				0.151
No	16 (72.73)	10 (90.91)	6 (54.55)	
Yes	6 (27.27)	1 (9.09)	5 (45.45)	
Patient code status at discharge, n (%)				0.301
Full code	15 (68.18)	9 (81.82)	6 (54.55)	
DNR CCA or (DNR/DNI)	2 (9.09)	1 (9.09)	1 (9.09)	
DNR CC (comfort care only)	5 (22.73)	1 (9.09)	4 (36.36)	
Patient NIHSS on admission Median [IQR]	18.50 [10.00, 22.75]	21.00 [18.50, 24.00]	14.00 [6.50, 18.50]	0.065
Patient NIHSS on discharge Median [IQR]	13.50 [10.00, 16.00]	13.00 [10.50, 15.00]	14.00 [8.50, 19.00]	0.869
Patient mRS at baseline Median [IQR]	0.00 [0.00, 0.00]	0.00 [0.00, 0.50]	0.00 [0.00, 0.00]	0.654
Patient mRS on discharge Median [IQR]	4.00 [4.00, 4.75]	4.00 [3.50, 4.00]	4.00 [4.00, 5.50]	0.121
Patient disposition at discharge, n (%)				0.278
Inpatient rehabilitation	6 (27.27)	4 (36.36)	2 (18.18)	
Skilled nursing facility	11 (50.00)	6 (54.55)	5 (45.45)	
Hospice	5 (22.73)	1 (9.09)	4 (36.36)	
Patient mortality at discharge, n (%)	5 (22.73)	1 (9.09)	4 (36.36)	0.309
Length of stay Median [IQR]	17.00 [13.00, 20.75]	17.00 [13.00, 20.00]	17.00 [11.00, 21.00]	0.818
Surrogate age Mean (SD)	55.82 (12.64)	54.18 (15.59)	57.45 (9.30)	0.557
Surrogate age Median [IQR]	57.00 [52.00, 62.75]	57.00 [48.50, 63.50]	57.00 [52.00, 62.50]	0.843
Surrogate Sex, n (%)				1.000
Male	6 (27.27)	3 (27.27)	3 (27.27)	
Female	16 (72.73)	8 (72.73)	8 (72.73)	
Surrogate race, n (%)				0.121
Caucasian	18 (81.82)	10 (90.91)	8 (72.73)	
African American	3 (13.64)	0 (0.00)	3 (27.27)	
Asian	1 (4.55)	1 (9.09)	0 (0.00)	
Surrogate education (n=21), n (%)				0.009
High school	6 (28.57)	6 (60.00)	0 (0.00)	
Some college	6 (28.57)	2 (20.00)	4 (36.36)	
Advanced degree	9 (42.86)	2 (20.00)	7 (63.64)	
Surrogate marital status (n=21), n (%)				0.510
Single	3 (14.29)	2 (20.00)	1 (9.09)	
Married or living with partner	17 (80.95)	8 (80.00)	9 (81.82)	
Divorced or separated	1 (4.76)	0 (0.00)	1 (9.09)	
Surrogate language, n (%)				1.000
English	21 (95.45)	11 (100.00)	10 (90.91)	
Spanish	1 (4.55)	0 (0.00)	1 (9.09)	
Surrogate religion (n=21), n (%)				0.620
Catholic	1 (4.76)	0 (0.00)	1 (9.09)	
Protestant or other Christian	16 (76.19)	8 (80.00)	8 (72.73)	
Not specified	4 (19.05)	2 (20.00)	2 (18.18)	

Abbreviations: NIHSS = NIH Stroke Scale; mRS = Modified Rankin Scale. All p-values < 0.05 are significant. Comparisons between routine care and palliative care groups were conducted using two-sample t-tests for normally-distributed continuous variables (i.e., (mean (SD)) and Mann−Whitney U-tests for non-normally-distributed continuous variables (i.e., (median [IQR]) as well as Fisher's exact test for categorical variables with small sample sizes.

Table 2. *Study Outcome Assessment Timeline.*

	Questionnaire on Communication (QoC)
Time 1	Day 1 − 3 of NCCU care (prior to palliative care consultation)
Time 2	Day 5 − 7 of NCCU care or prior to discharge
	Decisional Conflict Scale (DCS)
Time 1	Day 1 − 3 of NCCU care (prior to palliative care consultation)
Time 2	Day 5 − 7 of NCCU care or prior to discharge
	Hospital Anxiety and Depression Scale (HADS)
Time 1	Day 1 − 3 of NCCU care (prior to palliative care consultation)
Time 2	Day 5 − 7 of NCCU care or prior to discharge
Time 3	Telephone survey at 3 months
	Post-Traumatic Stress Disorder Checklist for DSM-5 − Civilian version (PCL- 5)
Time 3	Telephone survey at 3 months

Study outcomes were assessed through a series of validated surveys given to both groups of participants during the three points, with two during their hospitalization, and one 3-months post-discharge.

Table 3. *Unadjusted regression coefficients and 95% confidence intervals for the Participant Total Scores across Different Measures and Time points.*

Characteristic	Overall	Standard care	Targeted Early Palliative Intervention	p-value
QoC				
Days 1to3	74.00 [65.25, 84.75]	74.00 [72.50, 83.50]	74.00 [61.00, 84.50]	0.742
Days 5to7	78.00 [64.25, 93.00]	75.00 [54.00, 88.50]	86.00 [68.50, 95.00]	0.224
DCS				
Days 1to3	32.50 [22.75, 41.00]	28.00 [21.00, 32.50]	39.00 [32.00, 43.50]	0.131
Days 5to7	24.50 [18.25, 34.00]	20.00 [17.00, 27.50]	34.00 [24.00, 48.50]	0.146
HADS total				
Days 1to3	17.50 [14.25, 24.00]	17.00 [14.50, 23.00]	19.00 [13.50, 22.00]	0.895
Days 5to7	17.00 [13.00, 21.25]	17.00 [12.50, 22.50]	17.00 [14.00, 19.00]	0.869
3 months*	14.00 [6.00, 15.00]	15.00 [14.25, 21.75]	7.00 [5.00, 14.25]	0.043
HADS anxiety				
Days 1to3	10.00 [8.25, 12.75]	10.00 [8.50, 13.00]	10.00 [9.00, 12.50]	0.817
Days 5to7	8.50 [7.00, 12.00]	8.00 [5.50, 12.00]	9.00 [8.00, 12.00]	0.428
3 months*	7.50 [5.00, 9.75]	9.50 [8.25, 10.00]	5.00 [3.75, 6.50]	0.016
HADS depression				
Days 1to3	9.00 [4.00, 10.00]	9.00 [5.00, 10.50]	9.00 [4.00, 9.00]	0.595
Days 5to7	7.00 [5.25, 10.00]	9.00 [5.50, 10.50]	6.00 [5.50, 8.50]	0.596
3 months*	5.00 [2.25, 7.75]	6.00 [5.00, 12.25]	2.50 [0.75, 6.50]	0.105
PCL-5				
3 months*	15.50 [8.50, 26.00]	26.00 [20.00, 26.75]	9.00 [6.75, 14.50]	0.033

Abbreviations: QoC = Questionnaire on Communication; DCS = Decisional Conflict Scale; HADS = Hospital Anxiety and Depression Scale; PCL5-3 = Post Traumatic Stress Disorder Checklist for DSM-5. All p-values < 0.05 are significant.

Data are presented as median (IQR). Comparisons between routine care and palliative care groups were conducted using Fisher's exact test for categorical variables with small sample sizes.

*6 patients had missing information, this was factored into analysis.

are limited and still being studied, and extra caution must be given to avoid SFPs. A randomized control trial conducted in 2014 with a total of 3,124 ICU patients over 14 sites revealed that the NCCU cohort as compared to the medical or surgical cohorts had fewer palliative care consultations, and discussions in prognosis within the first 72 hours of ICU stay; however, they also had more DNR orders at time of death, shorter ICU stays, shorter withdrawal time, and overall better family and nursing ratings of quality of dying.[31] We believe a key contributor that accounted for lack of significant difference in mortality between both groups in our study was due the fact that palliative care team consultation focused on patient and/or surrogate decision maker's understanding of disease process, prognostic awareness, and elements of shared decision-making in collaboration with the NCCU team, rather than solely on end-of-life discussions.

It is also important to note that our results differ from prior report that demonstrated no significant benefit from palliative check lists or integration of palliative care measures in a large set of NCCU patients of various diagnostic conditions.[5] This may be from the differences in sample size and selection criteria between both studies. It may

Table 4. *Clinical Presentations of Patient Cohorts.*

	Control or Intervention Arm	Hemorrhagic or Ischemic Stroke on Presentation	Stroke Mechanism	Location	Acute Stroke Interventions
1	Control	Ischemic with hemorrhagic transformation	Cardioembolic (Afib)	R M1 Occlusion (Complete Infarct)	IV tPA, hemicraniectomy (no thrombectomy due to core infarct too large)
2	Control	Ischemic	Cardioembolic (Afib)	L M1 Occlusion (Incomplete Infarct)	Thrombectomy with TICI 2B (outside of window for tPA)
3	Control	Hemorrhagic	Endocarditis	L Frontal IPH(ICH Score 1)	None (slight midline shift)
4	Control	Ischemic	Cryptogenic	R Proximal A2 Occlusion	None (outside of window for tPA and thrombectomy)
5	Control	Ischemic	Large Artery Atherosclerosis	R Cervical ICA and R M1 Occlusion (Complete Infarct)	None (outside of window for tPA, no thrombectomy due to core infarct too large)
6	Control	Ischemic	Cryptogenic vs. hypercoagulable	R M1 occlusion (Complete Infarct)	Thrombectomy attempted but failed, hemicraniectomy (outside of window for tPA)
7	Control	Ischemic	Cryptogenic	R Proximal A2 Occlusion	None (outside of window for tPA)
8	Control	Hemorrhagic	Cocaine and Amphetamine induced Vasculopathy	R Frontal IPH (ICH Score 2)	Craniotomy for hematoma evacuation
9	Control	Hemorrhagic	Cerebral Amyloid Angiopathy	L Frontal IPH (ICH Score 2)	None (slight midline shift)
10	Control	Ischemic	Cryptogenic	Basilar Occlusion (Incomplete Infarct)	Thrombectomy with TICI 2B (outside of window for tPA)
11	Control	Ischemic	Dissection of Left Internal Carotid Artery	Watershed Infarction in R MCA and ACA territories (Incomplete Infarct)	None (outside of window for tPA, no thrombectomy due to core infarct too large)
12	Intervention	Ischemic	Cardioembolic (Afib)	L M1 Occlusion (Incomplete Infarct)	IV tPA (no thrombectomy due to too heavy for OR table)
13	Intervention	Ischemic	Cardioembolic (Afib)	R M2 occlusion (Incomplete Infarct)	IV tPA, thrombectomy with TICI 2A
14	Intervention	Hemorrhagic	Hypertension, Coagulopathy in the setting of Anticoagulant use	Brainstem IPH and IVH	External ventricular drain placement
15	Intervention	Ischemic	Cardioembolic (Afib)	R M1 occlusion (Incomplete Infarct)	IV tPA, thrombectomy with TICI 2B
16	Intervention	Hemorrhagic	Hypertension, Coagulopathy in the setting of Anticoagulant use	R Frontal IPH with IVH (ICH score 2)	External ventricular drain placement
17	Intervention	Ischemic with hemorrhagic transformation	Cardioembolic (Afib)	R M3 Occlusion (Incomplete Infarct) complicated by L Frontal IPH and SAH	IV tPA
18	Intervention	Ischemic	Large Artery Atherosclerosis	R M1 Occlusion (Incomplete Infarct)	IV tPA, thrombectomy with TICI 3
19	Intervention	Ischemic	Large Artery Atherosclerosis	L P1 Occlusion (Incomplete Infarct)	Thrombectomy attempted but failed (outside of window for tPA)

Table 4 (*Continued*)

	Control or Intervention Arm	Hemorrhagic or Ischemic Stroke on Presentation	Stroke Mechanism	Location	Acute Stroke Interventions
20	Intervention	Ischemic	Cryptogenic	L M1 and M2 Occlusion (Incomplete Infarct)	IV tPA, thrombectomy with TICI 2B
21	Intervention	Hemorrhagic	Cerebral Amyloid Angiopathy	L Frontal IPH with IVH (ICH score 3)	None (patient not a candidate for surgical intervention due to age)
22	Intervention	Ischemic	Cryptogenic	L ICA and MCA Occlusions (Complete Infarct)	IV tPA (no thrombectomy due to core infarct too large)

Abbreviations: Afib = Atrial Fibrillation; L = left; R = right; IV = Intravenous; tPA = tissue plasminogen activator; MCA = Middle cerebral artery; M1 = first division of the middle cerebral artery; M2 = second division of the middle cerebral artery; ICA = Internal carotid artery; ACA = Anterir cerebral artery; A2 = second division of the anterior cerebral artery; PCA = posterior cerebral artery; P1 = first division of the posterior cerebral artery; ICH = Intracerebral hemorrhage; IPH = Intraparenchymal hemorrhage; SAH = Subarachnoid hemorrhage; TICI = Thrombolysis in cerebral infarction scale.

also be explained by optimal triggers and timing of palliative care consultations. We believe that patients and their surrogates should receive timely, transparent, individualized, and balanced information on their treatment options. Another consideration is that the intervention arm may have had more structured, comprehensive, and multidisciplinary family meetings as a result of the consultation. Thus, a cohesive and multidisciplinary paradigm is the key to successful and meaningful satisfaction within our patient population.

Our study did not identify differences in anxiety, depression, communication, or decisional conflict scales during acute hospitalization in either arm, which highlights the challenges patients and surrogate decision makers face in the acute phase of hospitalization, regardless of the approach to plan of care. However, early collaborative palliative care assessment did suggest potential benefit in long-term post-hospitalization mental health. Data on the optimal timing of palliative care intervention and the impact of these interventions on NCCU patients have started to emerge, but much has yet to be described. A better understanding of these outcomes can help guide the timely use of palliative care in the NCCU and refine models for palliative care consultation.

Limitations

This study has several important limitations. As this was a single center study with a small sample size with unadjusted variables, it was not powered to identify the true impact of early palliative intervention or allow for multivariate analysis. Furthermore, given the limit in population size we remained cautious to make any inference to statistical significance or non-significance regarding prognostic factors that may have potentially impacted shared decision making. Additionally, phone surveys inherently carry a non-response limitation, which affects the sample size of our three-month follow up surveys. However, this study did prove feasibility of study design, and future study is planned to achieve study power. Despite en block randomization with an allocation ratio of 1:1 to ensure similar baseline characteristics of enrolled participants, there was a statistically significant difference between the education status of the surrogate decision makers in each group, with a higher percentage of advanced degrees in the intervention arm. This may be a potential confounder in our results. Another limitation was exclusion of non-English speaking participants which may affect the generalizability of our results. Finally, is also important to note, as the majority of the participants were patient's surrogate decision makers, our sample was more a representation of the surrogate and indirect representations of the patients scores.

Conclusion

Collaboration between the intensive care and palliative care team with early palliative assessment is feasible and

may be beneficial in lowering anxiety, depression and PTSD symptoms in critically ill stroke patients and their surrogate decision makers. Further research is needed to validate these findings.

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