

Original Article

Palliative Care Use for Critically Ill Patients With Brain Metastases



Jennifer H. Kang, MD, Meghan Price, BS, Tara Dalton, MSc, Luis Ramirez, MS, Peter E. Fecci, MD, PhD, Arif H. Kamal, MD, MBA, MHS, Margaret O. Johnson, MD, Katherine B. Peters, MD, and Courtney R. Goodwin, MD, PhD

Department of Neurology, Duke University Medical Center, Durham, (J.H.K.) NC, USA; Duke University School of Medicine, Durham, (M.P., T.D.) NC, USA; Department of Neurosurgery, Duke University Medical Center, Durham, (L.R., P.E.F., M.O.J., K.B.P., C.R.G.) NC, USA; Department of Medicine, Duke University Medical Center, Durham, (A.H.K.) NC, USA

Abstract

Context. Critically ill patients with brain metastases (BM) face significant uncertainty regarding prognosis and survival and can benefit from Palliative care (PC). However, research regarding the role of PC in this population is lacking.

Objectives. We sought to compare BM patients admitted to an intensive care unit who received an inpatient PC consult (PC cohort) to those who did not (Usual Care, UC cohort).

Methods. We performed a single-institution retrospective cohort analysis. Our outcome variables were mortality, time from intensive care unit admission to death, disposition, and change in code status. We also evaluated PC's role in complex medical decision making, symptom management and hospice education.

Results. PC consult was placed in 31 of 118 (28%) of patients. The overall mortality rates were not statistically different (78.8% vs. 90.3%, $P=0.15$, UC vs. PC cohort). Patients in the PC cohort had a shorter time to death, higher rate of death within 30 days of admission, increased rate of discharge to hospice, and increase percentage of code status change to "do not attempt resuscitation" during the admission. The primary services provided by PC were symptom management ($n=21$, 67.7%) and assistance in complex medical decision making ($n=20$, 64.5%).

Conclusion. In our patient cohort, PC is an underutilized service that can assist in complex medical decision making and symptom management of critically ill BM patients. Further prospective studies surveying patient, family and provider experiences could better inform the qualitative impact of PC in this unique patient population. *J Pain Symptom Manage* 2021;62:927–935. © 2021 American Academy of Hospice and Palliative Medicine. Published by Elsevier Inc. All rights reserved.

Key Words

Brain metastases, critically ill cancer patients, palliative care, intensive care unit, supportive care

Key Message

This article describes a retrospective cohort analysis of the use of Palliative care (PC) in an understudied population—critically ill patients with brain metastases. The results suggest that PC aids with symptom management and complex medical decision making, and further prospective studies evaluating its impact are warranted.

Introduction

At least 20% of patients with cancer will develop brain metastases¹ (BM). As a result, BM patients and their caregivers face numerous medical and psychosocial needs.² These needs accompany the significant morbidity and mortality³ related to both the disease and its treatment, alongside concerns regarding prognosis and survival.¹ Such needs are particularly evident

Address correspondence to: Jennifer H. Kang, MD, Duke University Medical Center, 2301 Erwin Road, Durham, NC 27710, USA. E-mail: jennifer.kang@duke.edu

Accepted for publication: 3 May 2021.

when BM patients are admitted to an intensive care unit (ICU), where uncertainty regarding outcomes from the BM, primary cancer, and/or complications of acute organ failure may all converge.

Palliative care (PC) is a subspecialty that focuses on symptom relief, family support, and effective communication regarding goals of care.⁴ In the outpatient setting, studies demonstrate an association of early PC in patients with advanced cancer with higher quality of life, less aggressive end-of-life care, lower rates of depression, and longer survival.⁵⁻⁷ Early PC reduces depression, stress and psychological distress of family members, and more patients who receive early PC as an outpatient have resuscitation preferences documented in the medical record.⁸⁻¹⁰

The ICU differs from the outpatient setting in many ways. An ICU admission is associated with high rates of patient and family distress by nature of its environment and the procedures that occur.¹¹⁻¹⁵ In one study, up to 40% of cancer patients admitted to an ICU admitted to having depression, with up to 75% of responders reporting pain, anxiety, sleep disturbance, and unsatisfied hunger and thirst at moderate to severe levels.¹¹ Another study demonstrated that patients who died in an ICU or hospital had worse quality of life and more physical and emotional distress at the end-of-life compared with those who died at home with hospice.¹² In regards to caregivers, ICU deaths are associated with higher rates of post-traumatic stress disorder and prolonged grief disorder than when patients die at home with hospice.¹²⁻¹⁵

Multiple interventions to integrate PC for the general, non-BM ICU population have been published,¹⁶ but are limited by small studies and heterogeneity. In these studies, PC interventions in the ICU have shown improved quality, quantity and content of communication and decreased distress in family members, without changing family satisfaction or impacting mortality.¹⁶

BM patients are a unique group of patients with high symptom burden and high rates of impaired communication and decision-making capacity^{17,18} due to the location of their tumors. For these patients, there is a unique opportunity for PC to improve patient symptoms and support their family members. Studies of PC interventions for critically ill BM patients are lacking. Current studies combine BM patients with patients with primary brain tumors and/or include any inpatient setting, not just an ICU.^{19,20}

In this retrospective, observational cohort study, we evaluate the utilization and impact of inpatient PC on BM patients admitted to an ICU for an acute indication. The goal was to define better the use of PC in this specific population and provide a basis for further prospective studies. For ICU patients who received a PC consult, we hypothesized that we would observe similar mortality rates, shorter hospital length of stays, and increased referrals to inpatient hospice.

Methods

We performed a single-institution retrospective cohort analysis of patients with a previous diagnosis of BM who were admitted to a Duke University Health System (DUHS) ICU for an acute, unplanned medical or surgical indication between October 1, 2015 and December 31, 2018. Using a case-control study design, we compared patients who received an inpatient PC consult to a cohort of those who did not. We examine differences in outcome, including mortality, length of stay and discharge disposition, as well as the impact on patient and family experience. This study was approved by the Duke Institutional Review Board.

Patient Care Sites

The DUHS is comprised of one major academic medical center and two smaller teaching affiliates located in the Durham-Raleigh, North Carolina area. All three centers have ICUs and offer comprehensive services including an inpatient PC consultation service and brain tumor neurosurgical procedures. The main university hospital has multiple ICUs, including a specialized neurological ICU.

Patient Sample

BM patients admitted to a DUHS hospital during the study period were identified using ICD-10 codes (C79.31) associated with their billed encounter using software (Oracle SQL Developer) to screen the electronic medical record database (Clarity). This list was manually reviewed to ensure patients met the following inclusion and exclusion criteria. We included adult patients who were 18 years and older with BM who were admitted to an ICU of one of the three hospitals and excluded patients admitted to a non-ICU floor. We included patients admitted with an acute medical or surgical indication to the ICU, and excluded patients admitted to the ICU for routine post-operative monitoring. We excluded patients with primary brain tumors and those with spine metastases only (i.e., without BM). Patients with BMs and leptomeningeal disease were included. We defined two cohorts from our sample: those who did versus those who did not receive an inpatient PC consult. PC consultation was defined as an inpatient consult placed in the electronic medical record followed by at least one documented evaluation by the inpatient PC team. PC consultations were not interchangeable with hospice care referrals.

Data Collection

Data were abstracted from the electronic medical record. The following information was collected: patients' demographics, clinical history, functional status, PC intervention characteristics, hospital length of stay (LOS), disposition, code status, and survival data.

Functional status was estimated by whether the patient was ambulatory and independent before admission as documented in the admission history and physical and case management initial assessment notes. The patients' body mass index and American Society of Anesthesiologists physical status class obtained from anesthesia notes during the admission stay or within three months before admission, where applicable, or the admission history and physical, and was used to reflect the severity of medical comorbidities.²¹

PC Cohort Evaluation

Patients identified as having received a PC consultation while in the ICU had the following information collected from the electronic medical record: time from ICU admission until consult placed, the reason for PC consult as denoted in the initial PC consultation note, and whether the PC team assisted in any of the following: complex medical decision making, hospice education, symptom management, and/or emotional support. PC consultation notes follow a standard template that explicitly state the date of consultation, the reason for consultation (i.e., assist with complex medical decision making, symptom management), evaluation of the medical and social situation, discussions with the primary team, and discussions with the patient and/or families. Notes indicate whether a family meeting took place, and when applicable, the members involved in the meeting, as well as the content of the discussion. Often in PC consultation notes, services provided are explicitly stated (i.e., assistance with goals of care, hospice education, symptom management, emotional support) and any descriptions of family and/or patient feedback to their services.

Outcome Variables

Outcome measures included hospital mortality, death within 30 days of admission, code status change from "Full" to "Do not attempt resuscitation" (DNAR) during that admission, hospital length of stay, and discharge disposition. We described the PC intervention data collected, as described in the above Data Collection section. Descriptive statistics included the reason for the consult, time from admission to PC consult, and services provided (i.e., assistance with complex medical decision making, symptom management, hospice education, addressing emotional distress, and assistance in identifying a healthcare power of attorney).

Statistical Analysis

The statistical analysis plan was formulated with a statistician, who performed the data analysis. Standard descriptive statistics were used to summarize the data, namely the means and standard deviations for continuous variables and the frequency distributions for categorical variables. Group differences were analyzed

using student t-test for continuous variables or the Pearson and Fisher exact tests for categorical variables. All analyses were performed using Statistical Analysis Software (SAS 9.4 Cary, NC). Level of statistical significance was set a $P < 0.05$ in all analyses.

Results

Patient Population

We identified 443 BM patients admitted to a DUHS hospital between October 1, 2015 and December 31, 2018. Of the 303 admitted to an ICU, 192 were excluded because they were admitted for routine post-operative monitoring. A total of 111 patients met inclusion criteria and were analyzed. Thirty-one patients (28%) received an inpatient PC consult (PC cohort) and 80 patients (72%) did not (Usual Care, UC cohort).

The two groups were similar in their demographics, pre-admission functional status, surgical risk and primary cancer diagnosis (Table 1). The median age was 62 years old (range 27–88) and 51.4% of patients were female. The majority of patients in each cohort were ambulatory (68.8% vs. 83.9%, $P = 0.11$, in the UC cohort vs. PC cohort, respectively) and independent (58.8% vs. 74.2%, $P = 0.13$) immediately prior to his and/or her ICU illness. The most common cancer diagnosis in each cohort was lung cancer (53.8% vs. 48.4%, UC vs. PC cohort). The most common reason for admission in the UC cohort was due to respiratory compromise ($n = 21$, 26.3%), compared to suspected stroke based on presentation with neurological deficit in the PC cohort ($n = 10$, 32.3%) (Table 1, Fig. 1). There were similar rates of admission for neurologic decline (22.5% vs. 29%) and seizures (20% vs. 19.4%) between the UC cohort and PC cohort, respectively (Table 1, Fig. 1).

Outcomes

There were differences in hospital and overall mortality between the two groups, but they were not statistically significant (hospital mortality, 41.3% vs. 35.5%, $P = 0.58$; overall mortality - defined as death by end of study period, 31 December, 2020 - 78.8% vs. 90.3%, $P = 0.15$, UC Cohort vs. PC cohort) (Table 2, Fig. 2a). The UC cohort had a shorter length of stay compared to the PC cohort (median 6.5 days (range 1–38) vs. 9 days (range 2–33), $P = 0.02$, UC cohort vs. PC cohort). More patients who received a PC consult had their code status changed from Full code to a DNAR during the admission (Fig. 2a, 48.4% vs. 27.5%, $P = 0.02$, PC cohort vs. UC cohort). More patients in the PC cohort died within 30 days of admission (Fig. 2a, 82.8% vs. 42.5%, $P = 0.0002$). There was a significant difference in dispositions between the two groups (Table 2,

Table 1

Demographic, Medical and Oncological Characteristics of Patients with Brain Metastases Admitted to the Intensive Care Unit	UC cohort (n = 80)	PC cohort (n = 31)	Total (n = 111)	P-value
Age, median (range)	62 (27-88)	65 (43-81)	62 (27-88)	0.41
Female Gender, n (%)	44 (55.0)	13 (41.9)	57 (51.4)	0.22
BMI, mean (SD)	28.3 (6.49)	27.0 (6.80)	28.0 (6.58)	0.17
ASA class prior to admission ^a				0.44
2	4 (5.0)	1 (3.7)	5 (4.7)	
3	55 (68.8)	22 (81.5)	77 (72.0)	
4	21 (26.3)	4 (14.8)	25 (23.4)	
Prior to admission assessments, n (%)				
Ambulatory	55 (68.8)	26 (83.9)		0.11
Independent	47 (58.8)	22 (74.2)		0.13
Primary cancer diagnosis, n (%)				0.15
Breast	11 (13.8)	2 (6.5)	13 (11.7)	
Gastrointestinal	3 (3.8)	1 (3.2)	4 (3.6)	
Genitourinary	5 (6.3)	4 (12.9)	7 (6.3)	
Gynecological	0 (0.0)	2 (6.5)	2 (1.8)	
Head and Neck	2 (2.5)	0 (0.0)	2 (1.8)	
Lung	43 (53.8)	15 (48.4)	58 (52.3)	
Skin	9 (11.3)	4 (12.9)	13 (11.7)	
Other ^b	2 (2.5)	2 (6.5)	6 (5.4)	
More than one primary	5 (6.3)	1 (3.2)	6 (5.4)	
Reason for admission, n (%)				0.01
Neurological decline ^c	18 (22.5)	9 (29.0)	27 (24.3)	
Respiratory ^k	21 (26.3)	2 (6.5)	23 (20.7)	
Suspected stroke ^d	13 (16.3)	10 (32.3)	23 (20.7)	
Seizure	16 (20.0)	6 (19.4)	22 (19.8)	
Septic shock	5 (6.3)	0 (0.0)	5 (4.5)	
Hydrocephalus	4 (5.0)	0 (0.0)	4 (3.6)	
Central nervous system infection	2 (2.5)	0 (0.0)	2 (1.8)	
Other	1 (1.3)	4 (12.9)	5 (4.5)	

^aFour missing values in PC cohort.

^bOne Ewing Sarcoma, 3 unknown.

^cNeurologic decline indicates neurological decline clearly due to symptoms of brain metastases and not related to other reasons for admission documented.

^dSuspected stroke indicates admission was for rule out stroke based on presentation with neurological deficit, although the possibility of underlying brain metastases explaining deficit may not have been able to be completely ruled out based on neuro-imaging, ASA=American Society of Anesthesiologists, BMI=body mass index, PC=Palliative Care, UC=Usual Care.

Fig. 2b). A greater proportion of patients who received a PC consult were discharged to hospice ($n = 16, 51.6\%$ vs. $n = 4, 5\%$ in UC cohort), while more patients in the UC cohort went home or died in the hospital (home $n = 28, 35\%$ vs. $n = 0, 0\%$; dead $n = 32, 40\%$ vs. $n = 10, 32.3\%$, UC vs. PC cohort). Although there was no significant difference in overall mortality, the median survival in the UC cohort was 1.3 months (95% CI 0, 3) compared to 0.1 months (95% CI, 0, 0.5) in the PC cohort (Fig. 3).

PC Cohort Evaluation

The median time from admission to PC consult was 4 days (range 1–24) (Table 3). The predominant reasons a consult was placed was assisting families and patients with complex medical decision making ($n = 20, 64.5\%$) and symptom management ($n = 21, 67.7\%$) (Table 3).

PC provided direct assistance to patients who were able to participate in complex medical decision making and express their symptoms and goals of care. In six conversations (6/31, 19.3%), patients were able to clarify their wishes for comfort care and were transitioned

to hospice after a family discussion. In one instance (1/31, 3.2%), PC was able to help the patient identify a healthcare power of attorney; however, the patient died before a family meeting was able to be held. One patient received emotional support from the PC team, which subjectively enabled a more coherent discussion regarding symptoms and goals of care. Two patients expressed their desire to continue aggressive care; one was discharged to a skilled nursing facility and the other died in the hospital. All other patients (21/31, 67.7%) were unable to participate or had limited capacity to participate in decision making due to their neurological and medical condition.

The majority of the PC consults (20/31, 64.5%) resulted in family meetings related to clarifying current treatment options and providing support for families as they made complex medical decisions regarding care of their loved ones. In four instances (4/31, 12.9%), PC was able to provide education to families regarding hospice care and coordinate with outside facilities and providers to arrange a hospice facility best suitable for the patient. In five instances (5/31, 16.1%), family conversations resulted in continuing to pursue aggressive care,

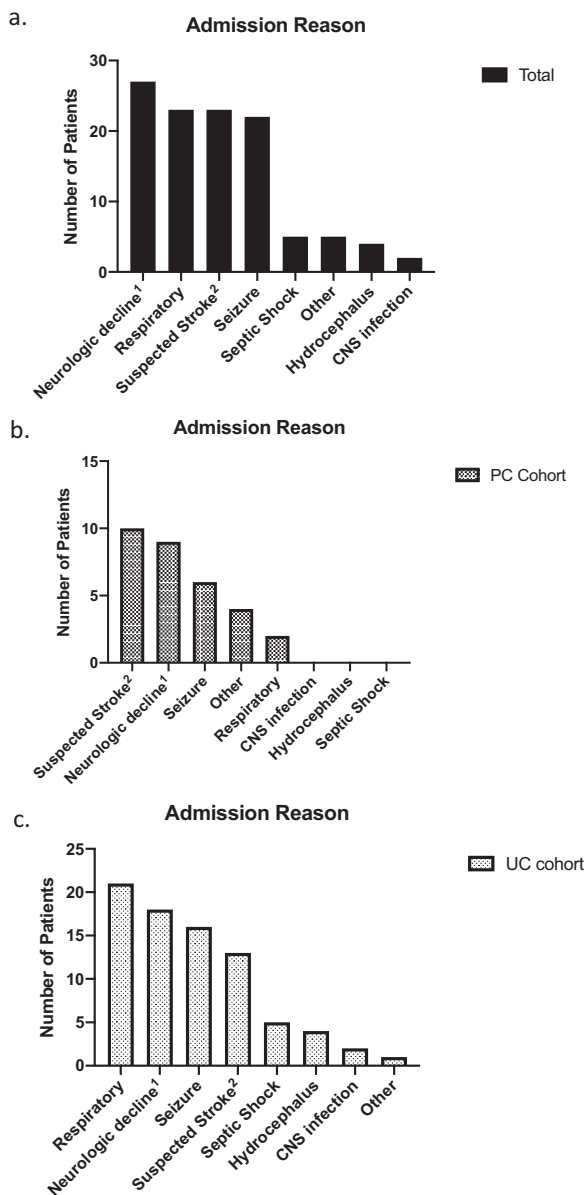


Fig. 1. Reasons for Admission to the Intensive Care Unit. a) Admission reason for all patients. b) Admission reason for patients who received an inpatient Palliative care consult (PC cohort). c) Admission reason for patients who did not receive an inpatient PC consult (Usual Care, UC, cohort). ¹Neurologic decline indicates neurological decline due to symptoms of brain metastases and not related to other reasons for admission documented ²Suspected stroke indicates admission was for rule out stroke based on presentation with neurological deficit and neuro-imaging, although the possibility of underlying brain metastases explaining deficit may not have been able to be completely ruled out based on neuro-imaging.

and these patients were all discharged to skilled nursing facilities. In all PC family meetings, families were able to express previous desires of their loved ones, have additional explanation regarding implications of code status,

and receive emotional support, per documentation in the electronic medical record.

Discussion

In this retrospective, cohort study, we described the admission characteristics of BM patients admitted to an ICU in an academic health system, as well as the utilization and impact of PC consultation. We found that PC consultation was associated with significantly higher rates of code status change from Full Code to DNAR and discharge to hospice compared to those who did not receive PC consults, with differences in hospital and overall mortality that were not statistically significant.

Due to the limited sample size, statistical analyses were descriptive, and these highlighted some notable comparisons between the two groups. The hospital length of stay was longer for the PC cohort, although PC teams were often not consulted until halfway through a median 9 day length of stay. We hypothesize this was due to a couple reasons: first, because of the time it sometimes takes to coordinate and implement end of life conversations and decisions, and second, perhaps a longer length of ICU stay without improvement prompted the PC consult.

Those who received a PC consult were more likely to become DNAR during the admission and die within thirty days. It is possible that the patient’s reason for admission influenced the provider’s initiation of a PC consult to encourage withdrawal of care or hospice. More patients in the UC cohort were admitted for respiratory failure, and perhaps there was a more aggressive, disease management-oriented approach to care, given the advances in treatment of respiratory failure in the ICU. In contrast, the majority of PC patients were admitted to the ICU for a new neurological deficit attributed to possible stroke, and providers may have been more oriented to an approach focused on quality of life in a patient with a new, potentially debilitating neurological deficit in a patient with already compromised brain tissue.

Those who received a PC consult were more likely to be discharged to hospice, while more patients in the UC cohort were discharged home. This value must be taken in context, as the UC cohort was larger, a greater number of patients in the UC cohort died than went home, and none of the patients in the PC cohort went home. The median survival of the PC cohort was shorter, which likely represents the late nature of PC referrals in the BM patient population oftentimes for patients near death.

Differences in hospital and overall mortality may be attributed to the difference in rates of discharge to hospice. Overall mortality was greater for the PC cohort –

Table 2
Outcomes of Patients with Brain Metastases Admitted to an Intensive Care Unit and Who Received a Palliative Care Consult

	UC cohort (n = 80)	PC cohort (n = 31)	Total (n = 111)	P-value
Hospital mortality, n, (%)	33 (41.3)	11 (35.5)	44 (39.6)	0.58
Overall mortality, n (%)	63 (78.8)	28 (90.3)	91 (82.0)	0.15
Hospital Length of stay (days)				0.03
Mean (SD)	8 (6.8)	11 (7.7)	8.8 (7.17)	
Median (range)	6.5 (1, 38)	9 (2, 33)	7 (1, 38)	
Death within 30 days of admission, n (%)	34 (42.5)	24 (82.8) ^a	58 (53.2)	0.0002
Code status change to DNAR ^b , n (%)				0.02
No	39 (48.8)	6 (19.4)	45 (40.5)	
Yes	22 (27.5)	15 (48.4)	37 (33.3)	
DNAR on admission	19 (23.8)	10 (32.3)	29 (26.1)	
30-day readmission, n (%)	11 (13.8)	1 (3.3) ^c	12 (10.9)	0.12
Disposition, n (%)				<.0001
Home	28 (35.0)	0 (0.0)	28 (25.2)	
Acute rehab	5 (6.3)	0 (0.0)	5 (4.5)	
Left against medical advice	1 (1.3)	0 (0.0)	1 (0.9)	
Skilled nursing facility	10 (12.5)	5 (16.1)	15 (13.5)	
Hospice	4 (5.0)	16 (51.6)	20 (18.0)	
Dead	32 (40.0)	10 (32.3)	42 (37.8)	

^aUnable to verify date of death in 2 patients as they were transferred to other facilities.

^bDNAR = do not attempt resuscitation.

^cOne missing value, PC = palliative care, UC = usual care.

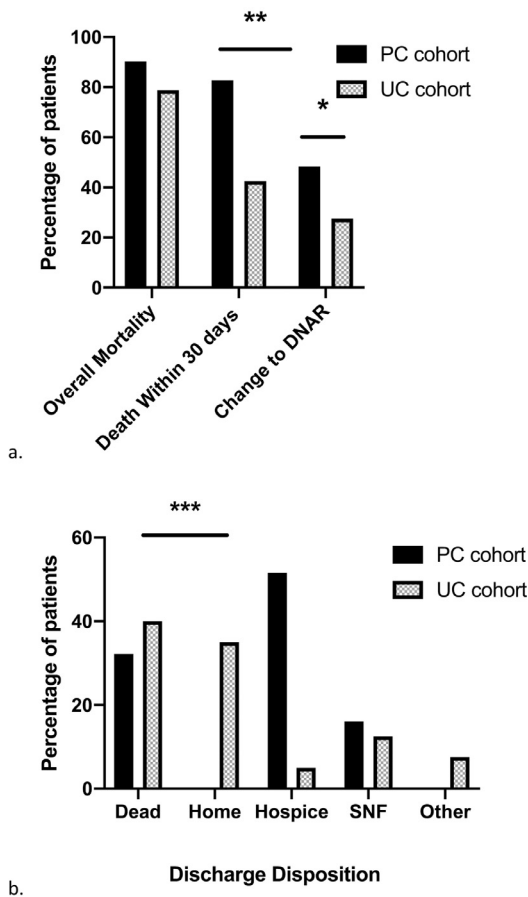


Fig. 2. Outcomes of patients with brain metastases admitted to an intensive care unit based on inpatient palliative care consult. a) *** $P < 0.0001$, ** $P < 0.001$, * $P < 0.05$; DNAR do not attempt to resuscitate, SNF = skilled nursing facility, PC = Palliative Care, UC = Usual Care.

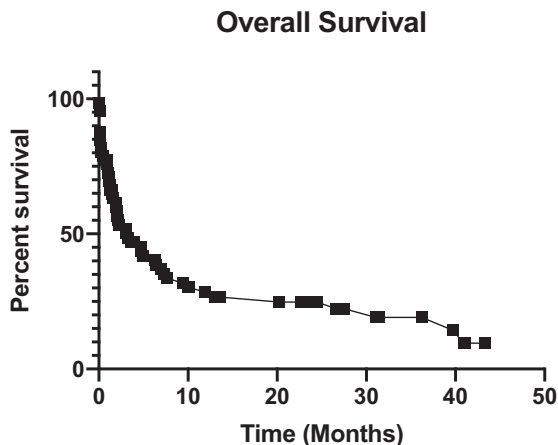
with a greater percentage of patients who were in hospice, more patients had aggressive, life-prolonging therapies withdrawn with an expectation of imminent death. The hospital mortality was greater for the UC cohort likely because most died while receiving aggressive treatments in the hospital, as opposed to the PC cohort, who likely were discharged from the hospital to home or a hospice facility before they died.

While our sample size limits statistical power, we did not detect a statistically significant difference between the mortality rates. Our findings mirror hospital mortality outcomes found in other non-BM ICU populations.^{16,22} Likely, the late nature of PC involvement results in no difference in mortality rates versus those who do not receive PC, but this would need to be evaluated in a prospective trial.

While other studies demonstrate a trend towards reduced hospital LOS for non-BM ICU patients who receive PC consult, this has not been a consistent finding.¹⁶ We found a longer hospital LOS in the BM PC cohort, which may be attributed to a number of reasons as stated, including longer time to for PC to create and institute a discharge plan reflective of patient and family wishes. Alternatively, a longer clinical course may be what prompted the PC consult. The median time from ICU admission to PC consult (4 days) in our PC cohort was slightly longer compared to other studies evaluating PC intervention (2.81 days).²²

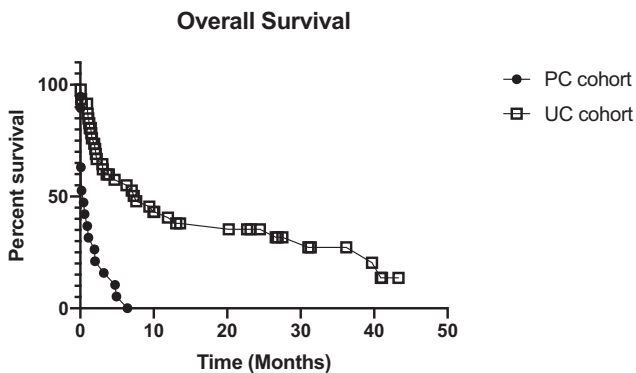
In non-BM ICU patients, PC interventions are shown to reduce distress and anxiety in family members and improved communication.¹⁶ In parallel, the majority of our PC cohort participated in family meetings with PC to allow for further dialogue regarding their care, emotions, and goals. Recommendations on symptom

a.



Total	# failed	Median survival in months (95% CI)	12-month survival (95% CI)	24-month survival (95% CI)	36-month survival (95% CI)
108	91	0.5 (0.1, 1.6)	17.9% (11.1%, 26.1%)	15.6% (9.2%, 23.5%)	12% (6.1%, 20.2%)

b.



Inpt PC consult	Total	# failed	Median survival in months (95% CI)	12-month survival (95% CI)	24-month survival (95% CI)	36-month survival (95% CI)
UC (n=80)	80	63	1.3 (0, 3)	24.9% (15.6%, 35.3%)	21.6% (12.9%, 31.9%)	16.7% (8.4%, 27.3%)
PC (n=28)	28	28	0.1 (0, 0.5)	0% (.%, .%)	0% (.%, .%)	0% (.%, .%)

Fig. 3. Kaplan Meier Survival Curves. a. Survival of All Patients ($n = 110$). b. Survival of Palliative Care cohort vs. Usual Care cohort. PC = palliative care, UC = usual care.

management occurred in at least 67% of our PC cohort group, slightly higher than reported in the literature for non-BM ICU patients.²² In our PC cohort, 32% of patients had a DNAR on admission and 48% changed their code status to DNAR after PC intervention. This finding is consistent with that reported by O'Mahoney et al. for non-BM ICU patients.²²

Our data on PC interventions revealed their frequent role in complex decision making and symptom management. Their role in hospice education and coordination was less prevalent, likely because case management often is able to assume this role at our institution. At other hospitals, this would add to the use of PC. Measurable assessments of the qualitative

Table 3

Reason for Palliative Care Consult and Time to Consult	
PC cohort (n = 31)	
Time from admission to PC consult (days), median (range)	4 (1.0-24.0)
Reason for PC consult, n (%)	
Complex medical decision making	20 (64.5)
Symptom management	21 (67.7)
Both complex decision making and symptom management	10 (32.0)
Hospice education	4 (12.9)

PC = palliative care.

impacts of PC consults are difficult to obtain, and this study was not designed to collect formal assessments but rather evaluate impact as best documented in the electronic medical record. However, from the PC notes, we were able to identify patients who identified a healthcare power of attorney and received additional emotional support as a result of the PC consult service.

Overall, our study results are similar to other PC interventions in non-BM ICU patients described in the literature,¹⁶ with more PC patients changing code status to DNAR, getting discharged to hospice, having an earlier time to death, with no statistical difference in mortality rates compared to those who do not receive PC. Definitively testing the effect of PC on mortality would require standardized entry points for patients into a study, such as through a prospective trial. In the non-BM ICU population, PC interventions have been shown to improve the quality, quantity and content of communication, and lead to decreased symptoms of distress and anxiety in family members, without affecting family satisfaction.¹⁶ Prospective studies of PC interventions for BM ICU patients should include surveys of patients and families addressing these areas. Also interesting for future studies is the impact of the inpatient PC intervention on the patient and family's postdischarge experience. Future studies evaluating the perspective of the ICU providers would also be valuable since their values and clinical knowledge may impact the approach to ICU care (i.e., aggressive versus palliative). Our PC consult rate (28%) has room for improvement. While our consult rate is higher than the reported rate in inpatient BM patients (between 12 and 19.6%),^{19,20,23} it was lower compared to non-BM ICU patients (34–57%).²⁴⁻²⁶ Future studies can explore whether low PC utilization is related to lack of awareness, misunderstanding of the value of PC consult, or simply lack of data supporting the use of PC consult.

This role of PC in BM patients is an understudied topic. We acknowledge that our data and analyses are limited by the retrospective design and limited sample size. Due to the limited sample size, rigorous statistical analyses were unable to be performed. Due to the retrospective nature of the study, data points regarding

patient's pre-admission functional status were extracted from admission and pre-admission notes and not formally evaluated. We also acknowledge the potential limitations of using documentation of PC notes as our resource to assess impact of the PC consultation, as there would be inconsistencies between documentation practices and interpretation by reviewers may be biased. Despite these limitations, our data provide a foundation to develop a prospective study to assess the impact of PC in this population.

Conclusion

Given the prevalence of BM patients and their prognostic uncertainties, multi-modality care should include PC consultation and early discussion regarding goals of care. Despite the small sample size and descriptive nature of our data, we observed that patients who received a PC consult more frequently changed code status and were more often discharged to hospice. PC consultation was not associated with significant differences in hospital or overall mortality. Future prospective studies to assess both the quantitative and qualitative impact of PC during hospitalization and post-discharge will validate these conclusions and may better describe the value of this service in improving the patient, family, and provider experience.

Disclosures and Acknowledgments

Conflict of Interest: The authors have no disclosures relevant to the current work, nor any true/perceived conflicts of interest.

Jennifer Kang: None

Meghan Price: None

Tara Dalton: None

Luis Ramirez: None

Peter Fecci: None

Arif Kamal: None

Margaret Johnson: None

Katherine B. Peters: None

C. Rory Goodwin: Received grants from the Robert Wood Johnson Harold Amos Medical Faculty Development Program, the Federal Food and Drug Administration, and the NIH/NINDS K12 NRCDP Physician Scientist Award. Consultant for Johnson&Johnson.

Acknowledgment: Dr. Kang would like to acknowledge the Duke Office of Physician Scientist and Development for their research support.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Achrol AS, Rennert RC, Anders C, et al. Brain metastases. *Nat Rev Dis Primers* 2019;5:5.
2. Maqbool T, Agarwal A, Sium A, Trang A, Chung C, Papadakos J. Informational and supportive care needs of brain metastases patients and caregivers: a systematic review. *J Cancer Educ* 2017;32:914–923.
3. Taillibert S, Delattre JY. Palliative care in patients with brain metastases. *Curr Opin Oncol* 2005;17:588–592.
4. Frontera JA, Curtis JR, Nelson JE, et al. Integrating Palliative care into the care of neurocritically ill patients: a report from the improving palliative care in the ICU project advisory board and the center to advance palliative care. *Crit Care Med* 2015;43:1964–1977.
5. Temel JS, Greer JA, Muzikansky A, et al. Early palliative care for patients with metastatic non-small-cell lung cancer. *N Engl J Med* 2010;363:733–742.
6. Bakitas M, Lyons KD, Hegel MT, et al. Effects of a palliative care intervention on clinical outcomes in patients with advanced cancer: the Project ENABLE II randomized controlled trial. *JAMA* 2009;302:741–749.
7. Kavalieratos D, Corbelli J, Zhang D, et al. Association between palliative care and patient and caregiver outcomes: a systematic review and meta-analysis. *JAMA* 2016;316:2104–2114.
8. Sun V, Grant M, Koczywas M, et al. Effectiveness of an interdisciplinary palliative care intervention for family caregivers in lung cancer. *Cancer* 2015;121:3737–3745.
9. Dionne-Odom JN, Azuero A, Lyons KD, et al. Benefits of early versus delayed palliative care to informal family caregivers of patients with advanced cancer: outcomes from the ENABLE III randomized controlled trial. *J Clin Oncol* 2015;33:1446–1452.
10. Ferrell B, Sun V, Hurria A, et al. Interdisciplinary palliative care for patients with lung cancer. *J Pain Symptom Manage* 2015;50:758–767.
11. Nelson JE, Meier DE, Oei EJ, et al. Self-reported symptom experience of critically ill cancer patients receiving intensive care. *Crit Care Med* 2001;29:277–282.
12. Wright AA, Keating NL, Balboni TA, Matulonis UA, Block SD, Prigerson HG. Place of death: correlations with quality of life of patients with cancer and predictors of bereaved caregivers' mental health. *J Clin Oncol* 2010;28:4457–4464.
13. Pochard F, Darmon M, Fassier T, et al. Symptoms of anxiety and depression in family members of intensive care unit patients before discharge or death. A prospective multicenter study. *J Crit Care* 2005;20:90–96.
14. Azoulay E, Pochard F, Kentish-Barnes N, et al. Risk of post-traumatic stress symptoms in family members of intensive care unit patients. *Am J Respir Crit Care Med* 2005;171:987–994.
15. Anderson WG, Arnold RM, Angus DC, Bryce CL. Post-traumatic stress and complicated grief in family members of patients in the intensive care unit. *J Gen Intern Med* 2008;23:1871–1876.
16. Aslakson R, Cheng J, Vollenweider D, Galusca D, Smith TJ, Pronovost PJ. Evidence-based palliative care in the intensive care unit: a systematic review of interventions. *J Palliat Med* 2014;17:219–235.
17. Walbert T, Khan M. End-of-life symptoms and care in patients with primary malignant brain tumors: a systematic literature review. *J Neurooncol* 2014;117:217–224.
18. Walbert T. Integration of palliative care into the neuro-oncology practice: patterns in the United States. *Neurooncol Pract* 2014;1:3–7.
19. Gofton TE, Graber J, Carver A. Identifying the palliative care needs of patients living with cerebral tumors and metastases: a retrospective analysis. *J Neurooncol* 2012;108:527–534.
20. Price M, Howell EP, Dalton T, et al. Inpatient palliative care utilization for patients with brain metastases. *Neuro-Oncology Practice* 2021:npab016. <https://doi.org/10.1093/nop/npab016>.
21. Owens WD, Felts JA, Spitznagel Jr. EL. ASA physical status classifications: a study of consistency of ratings. *Anesthesiology* 1978;49:239–243.
22. O'Mahony S, McHenry J, Blank AE, et al. Preliminary report of the integration of a palliative care team into an intensive care unit. *Palliat Med* 2010;24:154–165.
23. Rosenberg J, Massaro A, Siegler J, et al. Palliative care in patients with high-grade gliomas in the neurological intensive care unit. *The Neurohospitalist* 2020;10:163–167.
24. Walker KA, Mayo RL, Camire LM, Kearney CD. Effectiveness of integration of palliative medicine specialist services into the intensive care unit of a community teaching hospital. *J Palliat Med* 2013;16:1237–1241.
25. Lustbader D, Pekmezaris R, Frankenthaler M, et al. Palliative medicine consultation impacts DNR designation and length of stay for terminal medical MICU patients. *Palliat Support Care* 2011;9:401–406.
26. Hsu-Kim C, Friedman T, Gracely E, Gasperino J. Integrating palliative care into critical care: a quality improvement study. *J Intensive Care Med* 2015;30:358–364.