


# The Role of Palliative Care Consultation in Withdrawal of Life-Sustaining Treatment among ICU Patients Receiving Veno-Venous Extracorporeal Membrane Oxygenation (VV-ECMO): A Retrospective Case-Control Study

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## Abstract

**Background:** Extracorporeal membrane oxygenation (ECMO) has extended the survivability of critically ill patients beyond their unsupported prognosis and has widened the timeframe for making an informed decision about the goal of care. However, an extended time window for survival does not necessarily translate into a better outcome and the sustaining treatment is ultimately withdrawn in many patients. Emerging evidence has implicated the determining role of palliative care consult (PCC) in direction of the care that critically ill patients receive. **Objective:** To evaluate the impact of PCC in withdrawal of life-sustaining treatment (WOLST) among critically ill patients, who were placed on venovenous ECMO (VV-ECMO) at the intensive care unit (ICU) of a tertiary care hospital. **Methods:** In a retrospective observational study, electronic medical records of 750 patients admitted to the ICU of our hospital between January 1, 2015, and October 31, 2021, were reviewed. Data was collected for patients on VV-ECMO, for whom WOLST was withdrawn during the ICU stay. Clinical characteristics and the underlying reasons for WOLST were compared between those who received PCC (PCC group) and those who did not (non-PCC group). **Results:** A total of 95 patients were included in our analysis, 63 in the PCC group and 32 in the non-PCC group. The average age of the study population was  $48.8 \pm 12.6$  years, and 64.2% were male. There was no statistically significant difference between the two groups in terms of demographics or clinical characteristics at the time of ICU admission. The average duration of ICU stay and VV-ECMO were  $14.1 \pm 19.9$  days and  $9.4 \pm 16.6$  days, respectively. The number of PCC visits was correlated with the length of ICU stay. The average duration of ICU stay ( $40.3 \pm 33.2$  days vs  $27.8 \pm 19.3$  days,  $P = .05$ ) and ECMO treatment ( $31.9 \pm 27$  days vs  $18.6 \pm 16.1$  days,  $P = .01$ ) were significantly longer in patients receiving PCC than those not receiving PCC. However, the frequency of life sustaining measures or the underlying reasons for WOLST did not significantly differ between the two groups ( $P > .05$ ). **Conclusion:** Among ICU patients requiring ECMO support, longer duration of ICU stay and treatment with a higher number of life-sustaining measures seemed to be correlated with the number of PCC visits. The underlying reasons for WOLST seem not to be affected by PCC.

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## Keywords

Intensive Care Unit, ICU , ECMO, Prognosis, Mortality , Life-sustaining Treatment , Extracorporeal

## Key Message

This study demonstrates clinical characteristics of patients who received life-supporting measures via VV-ECMO at the intensive care unit due to acute respiratory distress syndrome but were later withdrawn from life-sustaining treatment. The results showed that palliative care consult is directly associated with an increased duration of treatment with VV-ECMO and longer duration of ICU stay.

## Introduction

With the advancement of medical technology and increasing availability of state-of-the-art life-extending equipment such as extracorporeal membrane oxygenation (ECMO), the narrow window of making a conscious decision about the goal of care by critically ill patients' advance directives has significantly widened.<sup>1-3</sup> Among different ECMO modalities, the veno-venous ECMO (VV-ECMO) has been exclusively used for patients with acute respiratory distress syndrome (ARDS).<sup>1,4-6</sup> However, in critically ill patients with poor prognosis, extending the duration of receiving life supporting measures via treatment with ECMO, might not seem a very cost-effective way of utilizing the healthcare system resources<sup>7</sup> and has been even ethically debated.<sup>8,9</sup>

A medically unjustifiable continuation of care in these cases, also referred to as “a bridge to nowhere”, is burdensome, costly to the healthcare system and emotionally overwhelming to the patients' next of kin. Nevertheless, withdrawal of life-sustaining treatments (WOLST) such as that with VV-ECMO is not a straightforward decision to attain, not by the healthcare providers or by the patient's advance directives. Palliative care consult (PCC) uses an interdisciplinary patient/family-centered approach focusing on the improvement of patient's and/or their family's quality of life rather than only focusing on life-extending measures.<sup>10,11</sup> Despite its proven benefits in improving the quality of life of patients, increasing the satisfaction of their families and healthcare providers, and decreasing the costs of care through more efficient comfort measures,<sup>12-15</sup> PCC seems to be underutilized in the management of patients with critical illnesses.<sup>16-18</sup> Additionally, few studies have demonstrated the potential benefits of PCC among patients receiving treatment with ECMO,<sup>19-21</sup> and none among those on VV-ECMO. Hence, we conducted this study to demonstrate the clinical characteristics of critically ill patients receiving VV-ECMO and to compare factors associated with WOLST among those receiving PCC and those not receiving PCC.

## Methods

### Study Design

This was a retrospective observational study in a tertiary care hospital affiliated with the University of Texas Health Science Center at Houston, TX. The institutional review board of our hospital approved the study protocol and exempted the investigators from obtaining an informed consent due to the retrospective nature of this investigation and collection of the data in an unidentifiable manner.

### Patients

Electronic medical records of adult patients (age  $\geq 18$  years old), who required VV-ECMO for any clinical indications between January 1, 2015, and October 31, 2021, were reviewed. Patients were included if they were on VV-ECMO for more than 48 hours and the WOLST with ECMO occurred during the same ICU stay. Those who received VV-ECMO for less than 48 hours were excluded, due to uncertain causes of death.

### Palliative Care Consultation

At our center, PCC is provided through a joint effort between physicians, physician assistants, social workers, case managers, and chaplains. The main objective of PCC is to facilitate an interdisciplinary approach to planning the goal of care between the primacy team and other individuals involved in the care of the patient, managing the end-of-life symptoms, and providing psychological support to the patient and/or their families. Additionally, PCC was mainly engaged in sufficient pain management, addressing non-pain related symptoms, clarifying the goal of care to the advance directive, help with the selection of surrogate decision maker or treatment preference, psychosocial or spiritual support, and education about the patient's critical condition and its pathological course leading to such poor prognosis.

### Data Collection

Data was collected on demographics (age and gender), code status (full code, do not intubate, do not resuscitate, do not intubate or resuscitate), clinical characteristics (comorbidities, indication for VV-ECMO, life-supporting measures [vasopressors or inotropic agents, continuous renal replacement therapy, mechanical ventilation, or non-ECMO cardiac care]), the main reason(s) for WOLST (futility, extreme pain, poor quality of life, or decision maker's wish), duration of ICU stay and supportive measure with VV-ECMO before and after

PCC, and characteristics of PCC. In terms of PCC, we documented the number of visits and the communication modes between PCC team members and the patient's family or advance directives, recorded the time interval between the initiation of VV-ECMO, PCC, and/or WOLST.

### Outcome Measures

The primary endpoint of this study was to determine the difference in demographics, clinical characteristics, hospital timelines, and causes of WOLST between patients on VV-ECMO receiving PCC and those not receiving PCC. The secondary endpoint of this study was to demonstrate characteristics of PCC visits and its relationship with ECMO and ICU stay.

### Statistical Analysis

Data were analyzed using STATA/IC 14.2 (StataCorp, College Station, TX). Comparison between PCC group and non-PCC group was done using Chi-squared test for categorical variables and Student's t-tests for continuous variables. Data are presented as number (%) or mean  $\pm$  standard deviation (SD) when appropriate. A *P* value was deemed statistically significant at  $< .05$ .

### Results

Out of 750 cases reviewed during the study period, 95 patients received VV-ECMO and died during the same ICU admission. Of these, 63 patients received PCC and 32 patients did not receive any PCC. The average age of the whole study population was  $48.8 \pm 12.6$  years and 64.2% were male. There was no statistically significant difference between the two groups in terms of demographics and primary clinical characteristics (Table 1). Indications for receiving VV-ECMO were acute respiratory distress syndrome (ARDS) in 83 patients (87.4%) followed by a failed lung transplant (3 patients, 3.2%) and trauma (2 patients, 2.1%). Additionally, hypertension, COVID-19, and diabetes were the most common comorbidities seen in 48.2%, 46.3%, and 30.5% of the patients, respectively. The advance directive for the patients was the spouse or a domestic partner in 67.4% of the cases. All the patients had a full-code status at the time of hospital admission and prior to the transfer to the ICU. Roughly, half of the patients had a chest tube inserted at the time of ICU admission.

#### Characteristics of Patients at the Time of Receiving PCC

At the time of PCC, 96.8% of the patients had a full-code status. The average duration of ICU stay and treatment with VV-ECMO were  $14.1 \pm 19.9$  days and  $9.4 \pm 16.6$  days, respectively. Out of 63 patients receiving PCC, 61 patients

(96.8%) were on mechanical ventilation and 28 patients were receiving vasopressors/inotropes (44.4%) (Table 2). Overall, the number of PCC visits was directly correlated with the length of ICU stay (Figure 1) and the duration of treatment with VV-ECMO (Figure 2).

#### Comparison of Patients' Characteristics at the Time of Withdrawal of Life-sustaining Treatment

The average duration of ICU stay was significantly longer in patients receiving PCC than in those without PCC ( $40.3 \pm 33.2$  days vs  $27.8 \pm 19.3$  days,  $P = .05$ ). The same pattern was also observed for the average duration of treatment with VV-ECMO ( $31.9 \pm 27$  days vs  $18.6 \pm 16.1$  days,  $P = .01$ ). However, the frequency of life supporting measures or the underlying reasons for the WOLST did not significantly differ between the two groups ( $P > .05$ ). For most of the patients, the decision to withdraw the care was futility and the surrogate's wishes (Table 3 and Figure 3).

#### Characteristics of PCC

The average number of PCC encounters with a physician and a physician assistant was  $1.6 \pm 2.5$  times and  $1.2 \pm 2.4$  times, respectively. Social workers and/or case managers performed an average of  $3.5 \pm 6.8$  PCC visits. Spiritual support by chaplain was provided in  $2.3 \pm 3.1$  of the PCC encounters. The average time interval from initiation of treatment with VV-ECMO to the first PCC encounter was  $9.4 \pm 16.6$  days and from the first PCC encounter to the WOLST was  $26.2 \pm 27$  days. At least one in-person encounter was provided for all the patients (100%). Telephone visits were the second most common mode of communication (61.9%). The PCC encounters mainly focused on spiritual support in 56 cases (88.9%), clarification of the goal of care in 52 patients (82.5%), and psychosocial support in 51 patients (81%). In terms of symptom management, non-pain related symptoms were the primary goal of PCC in 48 cases (76.2%) while pain management was provided in 47 cases (74.6%) (Table 4).

### Discussion

We described the characteristics of 95 patients who received supportive measures with VV-ECMO and for whom the decision to withdraw the treatment with ECMO was made by an advanced directive. Our study showed that the number of PCC visits was directly associated with the duration of ECMO support and the length of ICU stay. However, the underlying reasons for WOLST was not different between VV-ECMO patients, who received PCC and those who did not.

To the best of our knowledge, this is the first study comparing clinical parameters between patients on life-sustaining measures through VV-ECMO. A previous study on 91 deceased patients who had been withdrawn from

**Table 1.** Demographics, clinical characteristics, and primary in-hospital interventions among patients undergoing treatment with ECMO.

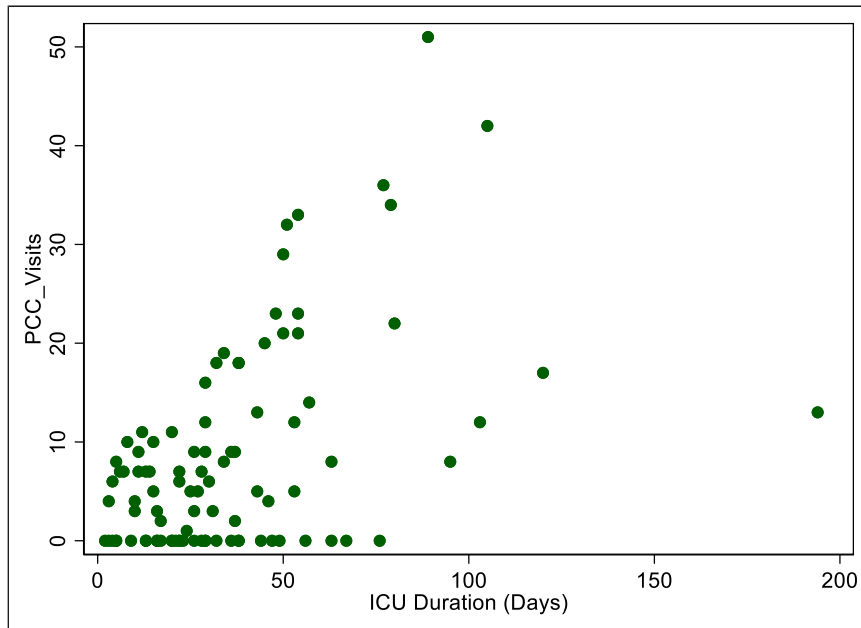
	Overall (N = 95)	Palliative Care Consult Group (N = 63)	No Palliative Care Consult Group (N = 32)	P Value
<b>Age, years</b> (mean±standard deviation [SD])	48.8±12.6	47.8±11.6	50.7±14.3	0.3
<b>Gender, n (%)</b>				
Male	61 (64.2%)	41 (65.8%)	20 (62.5%)	0.8
Female	34 (35.8%)	22 (34.9%)	12 (37.5%)	
<b>Indication for VV-ECMO, n (%)</b>				
Acute respiratory distress syndrome	83 (87.4%)	58 (92.1%)	25 (78.1%)	0.3
Pulmonary embolism	1 (1.05%)	0	1 (3.1%)	
Failed lung transplant graft	3 (3.2%)	1 (1.6%)	2 (6.2%)	
Trauma	2 (2.1%)	1 (1.6%)	1 (3.1%)	
Other	6 (6.3%)	3 (4.8%)	3 (9.4%)	
<b>Comorbidities, n (%)</b>				
Coronavirus Diseases 2019	44 (46.3%)	33 (52.4%)	11 (34.4%)	0.1
Cardiovascular diseases	4 (4.2%)	3 (4.8%)	1 (3.1%)	0.7
Congestive heart failure	5 (5.3%)	2 (3.2%)	3 (9.4%)	0.2
Chronic obstructive pulmonary diseases	7 (7.4%)	4 (6.3%)	3 (9.4%)	0.6
Asthma	9 (9.5%)	7 (11.1%)	2 (6.2%)	0.4
Chronic kidney diseases	10 (10.5%)	5 (7.9%)	5 (15.6%)	0.2
Diabetes mellitus	29 (30.5%)	19 (30.2%)	10 (31.2%)	0.9
Hypertension	46 (48.2%)	28 (44.4%)	18 (56.2%)	0.3
Hyperlipidemia	13 (13.7%)	9 (14.3%)	4 (12.5%)	0.8
Malignancy	5 (5.3%)	2 (3.2%)	3 (9.4%)	0.2
<b>In-hospital Interventions, n (%)</b>				
Percutaneous endoscopic gastrostomy tube	2 (2.1%)	1 (1.6%)	1 (3.1%)	0.6
Chest tube	46 (48.4%)	30 (47.6%)	16 (50%)	0.8
Tracheostomy	41 (43.2%)	30 (47.6%)	11 (34.4%)	0.2
<b>Decision maker</b>				.008*
Spouse or domestic partner	64 (67.4%)	46 (73%)	18 (56.2%)	
Child	14 (14.7%)	9 (14.3%)	5 (15.6%)	
Parent	9 (9.5%)	7 (11.1%)	2 (6.2%)	
Sibling	8 (8.4%)	1 (1.6%)	7 (21.9%)	
<b>Advance directive, n (%)</b>	9 (9.5%)	5 (7.9%)	4 (12.5%)	0.5
<b>Full code status, n (%)</b>				
At the hospital admission	95 (100%)	63 (100%)	32 (100%)	n/a
At intensive care unit admission	95 (100%)	63 (100%)	32 (100%)	n/a
At the time of first palliative care consult	61 (64.2%)	61 (96.8%)	0	<.0001*

VV-ECMO: Veno-venous extracorporeal membrane oxygenation.

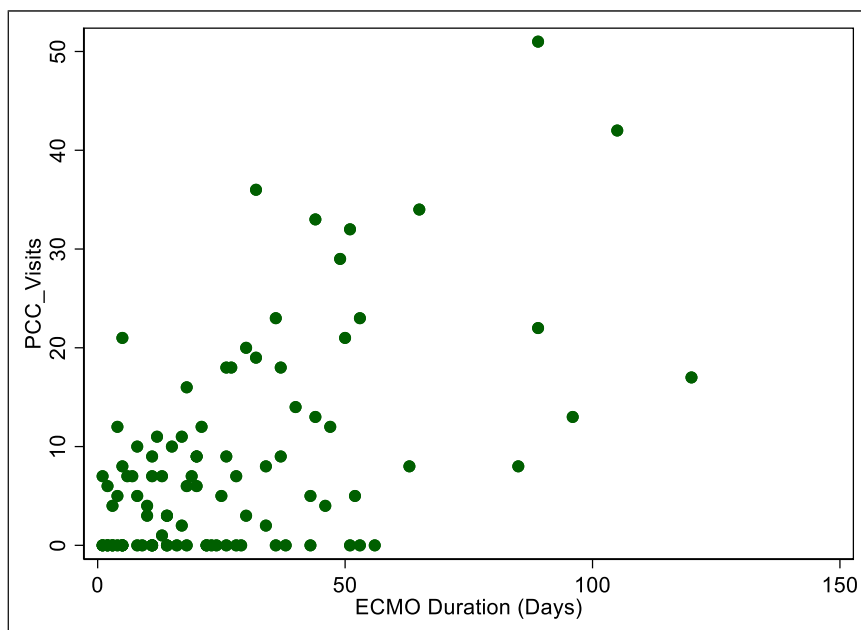
**Table 2.** Code status and life supportive measures for patients at the time of palliative care consultation (PCC).

	Total (N = 95)	Palliative Care Consult (N = 63)	No Palliative Care Consult (N = 32)	P Value
<b>Code status at PCC, n (%)</b>				<.0001*
Full code	93 (97.9%)	61 (96.8%)	32 (100%)	
Do not intubate	0	0	0	
Do not resuscitate	1 (1.05%)	1 (1.6%)	0	
Do not intubate/resuscitate	1 (1.05%)	1 (1.6%)	0	
Not available	0	0	0	
<b>Life supportive measures, n (%)</b>				n/a
Vasopressors or inotropic agents	28 (29.5%)	28 (44.4%)	n/a	
CRRT/RRT	27 (28.4%)	27 (42.8%)	n/a	
Mechanical ventilation	61 (64.2%)	61 (96.8%)	n/a	
Non-ECMO cardiac support	4 (4.2%)	4 (6.3%)	n/a	

PCC: Palliative care consult; N/A: Not applicable; CRRT: Continuous renal replacement therapy; RRT: Renal replacement therapy; ECMO: Extracorporeal membrane oxygenation.



**Figure 1.** Relationship between length of ICU stay and the number of visits for palliative care consult.



**Figure 2.** Relationship between duration of support with extracorporeal membrane oxygenation and the number of palliative care visits.

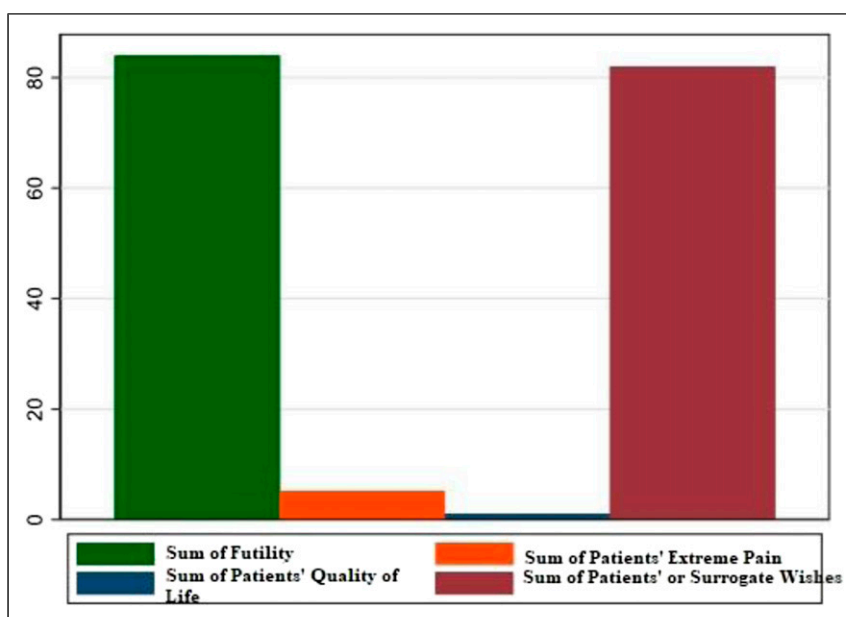
support with VA- ECMO showed a median duration of 4.0 days (interquartile range 8.8 days) for ECMO support, which was significantly longer for patients who received PCC compared to those who did not (8.8 days vs 2.0 days). Additionally, patients receiving PCC who received early consultation (<3 days) had significantly shorter duration of support with VA-ECMO compared to those receiving consultation at a later time after initiation of ECMO support (>3 days) (7.6 days vs 13.5 days).<sup>21</sup> In our study, the average

time interval from initiation of treatment with VV-ECMO to the first PCC encounter was  $9.4 \pm 16.6$  days and the time interval from the first PCC encounter to the WOLST was  $26.2 \pm 27$  days. Although PCC has been reported to be underutilized in patients requiring ECMO,<sup>22,23</sup> its direct correlation with a longer duration of treatment seems to be in debate. On one hand, PCC has been shown to educate the surrogates on the goal of care, which is essentially beneficial for those making decisions about life-sustaining measures for patients

**Table 3.** Comparison of critical care measures and life-sustaining treatments between patients with and without PCC at the time of WOLST.

	Total (N = 95)	Palliative Care Consult (N = 63)	No Palliative Care Consult (N = 32)	P Value
<b>ICU duration, days</b> (mean ± SD)	36.1±29.8	40.3±33.2	27.8±19.3	.05*
<b>ECMO duration, days</b> (mean ± SD)	27.4±24.6	31.9±27	18.6±16.1	.01*
<b>Life supportive measures, n (%)</b>				
Vasopressor/inotropes	78 (82.1%)	51 (81%)	27 (84.4%)	0.7
CRRT/RRT	66 (69.5%)	46 (73%)	20 (62.5%)	0.3
Mechanical ventilation	94 (98.9%)	62 (98.4%)	32 (100%)	0.5
Non-cardiac ECMO	5 (5.3%)	3 (4.8%)	2 (6.2%)	0.8
<b>Reason for WOLST, n (%)</b>				
Decision maker's wish	82 (86.3%)	56 (89%)	26 (81.2%)	0.3
Futility	84 (88.4%)	58 (92.1%)	26 (81.2%)	0.1
Extreme pain	5 (5.3%)	5 (7.9%)	0	0.1
Poor quality of life	1 (1.05%)	1 (1.6%)	0	0.5

N/A: Not applicable; PCC: Palliative care consult; CRRT: Continuous renal replacement therapy; RRT: Renal replacement therapy; ECMO: Extracorporeal membrane oxygenation; WOLST: Withdrawal of life-sustaining treatment; SD: Standard deviation.

**Figure 3.** Underlying reasons for the withdrawal of life-sustaining treatment among patients with and without palliative care consult.

with complex medical conditions. On the other hand, PCC engagement in the management of pain and non-pain related symptoms might inadvertently result in the prolongation of decision-making process by the patients or their advance directives on whether to continue or withdraw the life-sustaining measures. Hence, it is not surprising to see that PCC has a paradoxical impact on the duration of treatment with ECMO, and in turn, on the duration of ICU stay among patients with poor prognosis, especially those with ARDS or hemodynamic instability. Nonetheless, patients receiving treatment with ECMO constitute a population of patients for whom PCC provides an invaluable educational resource for decision-making as well as parallel psychosocial support.

In more than 80% of our cohort and specifically 90% in the PCC group, the decision to withdraw VV-ECMO was due to futility and extreme pain. Additionally, in majority of the cases, the role of PCC was clarification of the goal of care and symptom management, with non-pain related symptoms as important as pain management. More than 50% of the patients in the PCC group and about 30% in the non-PCC group had COVID-19 as the underlying causes of ICU admission. Previous studies have shown that engagement of PCC to address the goal of care in COVID-19 patients requiring ECMO is associated with a higher chance of changing the code status from full-code to the Do not resuscitate/DNR status.<sup>22,24</sup> Similar to our study, offering PCC has been

**Table 4.** Characteristics of care among 63 patients receiving palliative care consultation.

Characteristics	Mean±SD or Number (%)
<b>Average number of PCC encounters (mean ± SD)</b>	
With a physician (MD/DO)	1.6±2.5
With a physician assistant	1.2±2.4
With a nurse practitioner	0
With a social worker/case manager	3.5±6.8
With a chaplain	2.3±3.1
<b>PCC visits timing, days (mean ± SD)</b>	
Duration from VV-ECMO to palliative consultation	9.4±16.6
Duration from palliative Consultation to withdrawal	26.2±27
<b>Communication method, n (%)</b>	
In-person	63 (100%)
Telephone	39 (61.9%)
Teleconference	4 (6.3%)
Interpreter service	11 (17.4%)
<b>PCC Action, n (%)</b>	
Assistance with pain management	47 (74.6%)
Assistance with non-pain related symptoms	48 (76.2%)
Clarifying goals of care	52 (82.5%)
Determining surrogate decision maker	3 (4.8%)
Education about the condition	19 (30.2%)
Psychosocial support	51 (81%)
Spiritual support	56 (88.9%)
Helping to determine treatment preference	14 (22.2%)

associated with a longer duration of ICU stay. Besides the fact that COVID-19 was an evolving condition with uncertain prognosis at the time of collecting the data for this study, utilization of ECMO and PCC was also in its infancy for COVID patients requiring ICU level of care. While clarifying the goal of care seems as important as a task as symptom management to the advance directives of the patients at the end of life, this might be one of the explanations for the increased length of ICU stay and the longer duration of life-sustaining treatment with ECMO.

### Limitations

Our study has several limitations, which need to be considered when interpreting its results. As a retrospective study, it is not feasible to obtain data on all the parameters affecting the decision to withdraw support with VV-ECMO. Particularly, data is lacking on why PCC has been underutilized for patients with poor prognosis. Additionally, due to the conduction of this study in a single hospital, our study findings have limited generalizability to other inpatient settings. While our exclusive inclusion of patients on VV-ECMO makes study findings not applicable to those requiring VA-ECMO, it makes our results amenable for a population of ARDS patients on VV-ECMO which might benefit from PCC.

### Conclusion

Our study demonstrated the clinical characteristics of patients who were withdrawn from life-sustaining treatment with VV-ECMO showing that the number of PCC visits was directly associated with a longer duration of ECMO support and length of stay. Pain and futility were the main indications for WOLST among most of the patients. However, it remains to be determined which VV-ECMO patients benefit the most from PCC and what the best timeline would be.

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### References

1. Biancari F, Mariscalco G, Dalen M, et al. Six-month survival after extracorporeal membrane oxygenation for severe COVID-19. *J Cardiothorac Vasc Anesth*. Jul 2021;35(7):1999-2006. doi:10.1053/j.jvca.2021.01.027
2. Carlson JM, Etchill E, Whitman G, et al. Early withdrawal of life sustaining therapy in extracorporeal cardiopulmonary resuscitation (ECPR): results from the extracorporeal life support organization registry. *Resuscitation*. Oct 2022;179:71-77. doi:10.1016/j.resuscitation.2022.07.038
3. Vishram-Nielsen JKK, Foroutan F, Rizwan S, et al. Patients with fulminant myocarditis supported with veno-arterial extracorporeal membrane oxygenation: a systematic review and meta-analysis of short-term mortality and impact of risk factors. *Heart Fail Rev*. 2023;28:347-357. doi:10.1007/s10741-022-10277-z
4. Australia and New Zealand Extracorporeal Membrane Oxygenation ANZ ECMO Influenza Investigators, Davies A, Jones D, et al. Extracorporeal membrane oxygenation for 2009 Influenza A(H1N1) acute respiratory distress syndrome. *JAMA*. Nov 4. 2009;302(17):1888-1895. doi:10.1001/jama.2009.1535
5. Brogan TV, Thiagarajan RR, Rycus PT, Bartlett RH, Bratton SL. Extracorporeal membrane oxygenation in adults with severe respiratory failure: a multi-center database. *Intensive Care Med*. Dec 2009;35(12):2105-2114. doi:10.1007/s00134-009-1661-7
6. Dreier E, Malfertheiner MV, Dienemann T, et al. ECMO in COVID-19-prolonged therapy needed? a retrospective analysis of outcome and prognostic factors. *Perfusion*. Sep 2021;36(6):582-591. doi:10.1177/0267659121995997
7. Wirpsa MJ, Carabini LM, Neely KJ, Kroll C, Wocial LD. Mitigating ethical conflict and moral distress in the care of

- patients on ECMO: impact of an automatic ethics consultation protocol. *J Med Ethics*. 47, e63, Jan 13 2021;doi:[10.1136/medethics-2020-106881](https://doi.org/10.1136/medethics-2020-106881).
8. Williams SB, Dahnke MD. Clarification and mitigation of ethical problems surrounding withdrawal of extracorporeal membrane oxygenation. *Crit Care Nurse*. Oct 2016;36(5):56-65. doi:[10.4037/ccn2016504](https://doi.org/10.4037/ccn2016504)
  9. Abrams DC, Prager K, Blinderman CD, Burkart KM, Brodie D. Ethical dilemmas encountered with the use of extracorporeal membrane oxygenation in adults. *Chest*. 2014;145(4):876-882. doi:[10.1378/chest.13-1138](https://doi.org/10.1378/chest.13-1138)
  10. World Health Organization. *National Cancer Control Programmes: Policies and Managerial Guidelines*. Geneva, Switzerland: World Health Organization. <https://apps.who.int/iris/handle/10665/42494> (2002).
  11. Radbruch L, De Lima L, Knaul F, et al. Redefining palliative care-a new consensus-based definition. *J Pain Symptom Manage*. Oct 2020;60(4):754-764. doi:[10.1016/j.jpainsymman.2020.04.027](https://doi.org/10.1016/j.jpainsymman.2020.04.027)
  12. El-Jawahri A, Greer JA, Pirl WF, et al. Effects of early Integrated palliative care on caregivers of patients with lung and gastrointestinal cancer: a randomized clinical trial. *Oncol*. Dec 2017; 22(12):1528-1534. doi:[10.1634/theoncologist.2017-0227](https://doi.org/10.1634/theoncologist.2017-0227)
  13. Hughes MT, Smith TJ. The growth of palliative care in the United States. *Annu Rev Public Health*. 2014;35:459-475. doi:[10.1146/annurev-publhealth-032013-182406](https://doi.org/10.1146/annurev-publhealth-032013-182406)
  14. Kavalieratos D, Corbelli J, Zhang D, et al. Association between palliative care and patient and caregiver outcomes: a systematic review and meta-analysis. *Jama*. Nov 22. 2016;316(20):2104-2114. doi:[10.1001/jama.2016.16840](https://doi.org/10.1001/jama.2016.16840)
  15. Vanbutsele G, Pardon K, Van Belle S, et al. Effect of early and systematic integration of palliative care in patients with advanced cancer: a randomised controlled trial. *Lancet Oncol*. 2018;19(3):394-404. doi:[10.1016/s1470-2045\(18\)30060-3](https://doi.org/10.1016/s1470-2045(18)30060-3)
  16. Cheang MH, Rose G, Cheung CC, Thomas M. Current challenges in palliative care provision for heart failure in the UK: a survey on the perspectives of palliative care professionals. *Open Heart*. 2015;2(1):e000188. doi:[10.1136/openhrt-2014-000188](https://doi.org/10.1136/openhrt-2014-000188)
  17. Laube R, Sabih AH, Strasser SI, Lim L, Cigolini M, Liu K. Palliative care in hepatocellular carcinoma. *J Gastroenterol Hepatol*. 2021;36(3):618-628. doi:[10.1111/jgh.15169](https://doi.org/10.1111/jgh.15169)
  18. McAteer R, Wellbery C. Palliative care: benefits, barriers, and best practices. *Am Fam Physician*. Dec 15 2013;88(12):807-813.
  19. Dabi A, Rahman O. *Termination of Life Support*. StatPearls: StatPearls Publishing LLC; 2022.
  20. DeMartino ES, Braus NA, Sulmasy DP, et al. Decisions to withdraw extracorporeal membrane oxygenation support: patient characteristics and ethical Considerations. *Mayo Clin Proc*. 2019;94(4):620-627. doi:[10.1016/j.mayocp.2018.09.020](https://doi.org/10.1016/j.mayocp.2018.09.020)
  21. Godfrey S, Sahoo A, Sanchez J, et al. The role of palliative care in withdrawal of Venoarterial extracorporeal membrane oxygenation for Cardiogenic Shock. *J Pain Symptom Manage*. 2021;61(6):1139-1146. doi:[10.1016/j.jpainsymman.2020.10.027](https://doi.org/10.1016/j.jpainsymman.2020.10.027)
  22. Rao A, Zaaqoq AM, Kang IG, et al. Palliative care for patients on extracorporeal membrane oxygenation for COVID-19 Infection. *Am J Hosp Palliat Care*. Jul 2021;38(7):854-860. doi:[10.1177/10499091211001009](https://doi.org/10.1177/10499091211001009)
  23. Patel B, Secheresiu P, Shah M, et al. Trends and predictors of palliative care referrals in patients with acute heart failure. *Am J Hosp Palliat Care*. 2019;36(2):147-153. doi:[10.1177/1049909118796195](https://doi.org/10.1177/1049909118796195)
  24. Grouls A, Nwogu-Onyemkpa E, Guffey D, Chatterjee S, Herlihy JP, Naik AD. Palliative care impact on COVID-19 patients requiring extracorporeal membrane oxygenation. *J Pain Symptom Manage*. Oct 2022;64(4):e181-e187. doi:[10.1016/j.jpainsymman.2022.06.013](https://doi.org/10.1016/j.jpainsymman.2022.06.013)