Original Article

Predictive Factors for Cardiopulmonary Resuscitation Failure

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ABSTRACT

Objectives: Patients with chronic diseases are often admitted to the hospital through the emergency room of the hospital because of complaints of dyspnoea, urinary retention, decreased consciousness and cardiac arrest requiring resuscitation. The purpose of this study is to find predictive factors for failure of cardiopulmonary resuscitation (CPR) in patients of chronic diseases.

Materials and Methods: This cross-sectional study took medical records of patients who were carried out from primary healthcare center in Yogyakarta from 2017 to 2019. Bivariate statistical analysis used Fisher's exact test to determine the relative risk; if $P < 0.25$, then multivariate analysis with logistic regression continued with the backward method to obtain the odds ratio (OR).

Results: The results indicate that cardiac arrest patients with sepsis are most likely to fail at CPR, whereas male patients are 9.1 times (OR 9.1); patients with acidosis, 8.1 times (OR 8.1); and patients with asystole heart rhythm, 7.8 times (OR 7.8, $P < 0.05$). We can conclude that male patients with sepsis, acidosis or asystole heart rhythm will almost certainly fail to receive resuscitation.

Conclusion: Sepsis or septic shock, the male gender, acidosis, and asystole rhythm can be determinants of mortality in patients with chronic diseases who undergo CPR. It is necessary for one to test the application of the checklist or data from other hospitals and score the predictive factors to make the determination of the success of CPR easier.

Keywords: Cardiopulmonary resuscitation, Mortality, Palliative care, Risk factor

INTRODUCTION

Chronic and life-threatening diseases are increasingly occurring because of the development of medical science. Palliative care relieves the patient of pain and other aggravating symptoms and affirms that life and death are natural.[1] Some of the major disease diagnoses are handled in palliative care, namely, cardiovascular disease (38.4%), followed by cancer (34.01%), chronic obstructive pulmonary disease, HIV/AIDS, diabetes mellitus (DM) and other chronic diseases in small numbers.[2]

Cardiopulmonary resuscitation (CPR) in chronic disease patients who come to the hospital often encounters ethical problems such as the need to be resuscitated or not to be resuscitated.[3] This may be due to the assumption that cardiac arrest patients who are not resuscitated are considered untreated.[4] The decision not to resuscitate is basically meant for protecting the patient from invasive measures that may not be beneficial, but doctors often hesitate to discuss with the patient's family.[5] Limited resources in terms of rooms, medical equipment, and personnel indicate that clinicians have to make fast and accurate decisions regarding the management of palliative patients who are resuscitated. Clinicians should be able to predict patient survival after resuscitation, rather than prescribing measures that prolong the death process.[6] Energy resources, tools, and intensive rooms can ultimately be maximized to treat patients who really need and can expect their recovery, rather than being given to patients who are in the terminal phase.[5] There is a dilemma when determining whether to resuscitate

and where is the place of care after resuscitation related to chronic disease that cannot be treated.[7] The ethical dilemma between resuscitation and no resuscitation may be resolved if the prognosis of patients who come for resuscitation or post-resuscitation objectively can be made.

This study aims to find predictive factors for failure of CPR in patients of chronic diseases. The data can be checked as a predictor of whether a patient can still be expected to live or be successfully given resuscitation so that they can serve as a guide for explaining to the patient's family his/her chances of survival. This research should be conducted because until now, there has been no prediction of death or the failure of CPR in patients with chronic diseases.

MATERIALS AND METHODS

Study design

This study used a cross-sectional method, by taking data from the medical records of primary healthcare centre in Yogyakarta from 2017 to 2019.

Subjects

The inclusion criteria were age >18 years, a chronic disease, suffering from cardiac arrest, and previous resuscitation process. The exclusion criteria were previous traffic accident and current trauma. Patient identities (age and sex); diagnosis; comorbidities; heart rhythm; the number of CPR cycles; and resuscitation results, whether life or death; were taken and listed in a table. This research received ethical approval number 041/EC-EXEM-KEPK FKIK UMY/IV/2020.

Data analysis

The data obtained were then grouped based on the results, life, or death after resuscitation; then, Fisher's exact test was performed to see which factors had the most influence on the underarm success of patients undergoing CPR.

RESULTS

From medical record data, 66 subjects met the inclusion criteria. Sixty-six subjects met the criteria, 58 died or had failed resuscitation, and eight were successfully resuscitated or had return of spontaneous circulation (ROSC) but died later. There were 41 (62.1%) men and 25 (37.9%) women who received CPR in the inpatient room, emergency department, and ICU, with a mean age of 62.4 ± 13.8 years. The number of CPR cycles performed was divided into <5 times, amounting to 25 (37.9%) subjects and >5 times, totaling 41 (62.1%). The heart rhythm of the subjects obtained a picture of asystole, as many as 46 (69.7%); PEA, 6 (9.1%); VT/VF, 3 (4.5%); and others, 11 (16.7%). Based on the diagnosis and comorbidities, there was 1 patient (1.5%) subject with a malignancy factor, 20 patients (30.3%) with sepsis/septic shock, 22 (33.3%) with DM, 20 (30.3%) with cardiogenic shock, 19 (28.8%) with respiratory failure, 28 (42.4%) with chronic renal failure

(CKD), and 36 (54.5%) with acidosis; 58 patients (87.9%) died after CPR, and 8 (12.1%) lived or had ROSC [Table 1].

Fisher's exact test, bivariate statistical test, was carried out in the group of dead or alive subjects, and it was found that asystole, PEA and sepsis/septic shock had statistically significant differences ($P < 0.05$). The risk of death in patients with asystole was 1.37 times than that in those without asystole, and sepsis/septic shock was 1.21 times more than that in patients without sepsis/septic shock. PEA rhythms were found to be protective or have a 0.55 times lower risk of dying than without PEA. The risk of death by sex was 1.16 times; malignancy was 1.14 times; cardiogenic shock was 1.12 times; respiratory failure was 1.03 times; chronic renal failure was 1.03 times, and acidosis was 1.18 times, but it was not statistically significant [Table 2].

To show the risk factors that most influence the likelihood of a patient dying or an unsuccessful CPR, a multivariate analysis statistical test was performed using the backward logistic regression method. The variables tested were those that had a $P < 0.25$ in the bivariate test, including gender, asystole, PEA, sepsis, DM, cardiogenic, and acidosis. The multivariate result that had a significant effect was acidosis ($P = 0.035$, i.e. $P < 0.05$), with a risk of dying being 7.8 times; men had a 9.1 times risk of dying; sepsis patients were most likely to die; and acidosis patients had a risk of dying 8.1 times. Gender, sepsis/septic shock, and acidosis were not statistically significant but had a large OR value [Table 3].

DISCUSSION

Patients with chronic diseases and those under palliative care still vary in the management of cardiac arrest. Medical personnel, including doctors, generally can predict whether a patient's condition will worsen or improve based on intuition or prognostic factors. Prognostic factors can be determined based on the predictions and experience of physicians in clinical practice to produce estimates of life expectancy.[7,8] Several prognostic models have been developed based on these prognostic factors, such as the palliative prognostic score, the palliative prognostic index, and the Glasgow prognostic score, which are the most validated, but further studies are required to make them easier to understand.[9]

In this study, no patients with sepsis or septic shock survived or had ROSC after being treated with CPR. Other risk factors were men, who had a risk of dying 9.1 times; acidosis, 8.1 times; and asystole, the only factor that was statistically significant ($P < 0.05$), of 7.8 times. Male patients had more cardiac arrest and performed CPR than female patients.[10,11] Research by Ahmad *et al.*[12] indicated that male patients have more potential to be given DnR status (do not resuscitate) because they are included in the criteria for a low probability of CPR success. The success criteria for low CPR are patients with malignant disease, multi-organ failure, acute stroke, and bed-only activity.[13]

Table 1: Subject characteristics, comorbidities, diagnosis, and death or life outcomes.

Subject variables	Outcome				P	RR	CI 95%
	Dead		%				
	n	%	*n*	%			
Sex							
Male	38	92.7	3	7.3	0.128	1.16	0.94–1.44
Female	20	80.0	5	20.0			
Age							
≥ge yo	36	87.8	5	12.2	0.649	0.99	0.83–1.20
<60 yo	22	88.0	3	12.0			
Cycle							
<5	21	84.0	4	16.0	0.351	0.93	0.76–1.14
>5	37	90.2	4	9.8			
Asystole							
Yes	44	95.7	2	4.3	0.008*	1.37	1.02–1.83
No	14	70.0	6	30.0			
PEA							
Yes	3	50.0	3	50.0	0.020*	0.55	0.24–1.22
No	55	91.7	5	8.3			
VT/VF							
Yes	2	66.7	1	33.3	0.326	0.75	0.34–1.68
No	56	88.9	7	11.1			
Other							
Yes	9	81.8	2	18.2	0.399	0.92	0.28–1.23
No	49	89.1	6	10.9			
Malignancy							
Yes	1	100.0	0	0.0	0.879	1.14	1.04-1.25
No	57	87.7	8	12.3			
Sepsis							
Yes	20	100.0	0	0.0	0.045*	1.21	1.06-1.38
No	38	82.6	8	17.4			
Diabetes mellitus							
Yes	18	81.8	4	18.2	0.247	0.90	0.72-1.12
No	40	90.9	4	9.1			
Cardiogenic shock							
Yes	19	95.0	1	5.0	0.232	1.12	0.96-1.31
No	39	84.8	7	15.2			
Resp. failure							
Yes	17	89.5	2	10.5	0.582	1.03	0.85-1.24
No	41	87.2	6	12.8			
CKD							
Yes	25	89.3	3	10.7	0.538	1.03	0.86-1.23
No	33	86.8	5	13.2			
Acidosis							
Yes	34	94.4	2	5.6	0.079	1.18	0.97-1.44
No	24	80.0	6	20.0			

*P<0.05

The probability of success of CPR is low in patients undergoing surgery and cardiac arrest and in patients with non-shockable heart rhythms such as asystole, PEA and tachycardia.[14] Acidosis that is not handled properly can cause circulatory failure so that the supply of oxygen to the tissues is disturbed and can aggravate the condition of acidosis. Acidosis is the result of anaerobic metabolism due to lack of oxygen supply. If acidosis lasts for a long time, it can cause multi-organ failure.[12] Research by Trehan *et al.*[15] indicates that acidosis, which is characterized by an increase in lactic acid levels and a decrease in blood pH, is a predictor of death after CPR.[12] Increased lactate levels also occur in septic patients. Although there are still differences in the management of septic patients, there are advances in understanding the pathophysiology of sepsis.[15] The increase in lactic acid indicates hypoperfusion in the tissue and is associated with the cause of death.[16,17]

Table 2: Subjects who were dead or alive based on comorbid factors and diagnosis.

Subject variables	Outcome				P-value	RR	CI 95%
	Dead		Alive (ROSC)				
	n	%	*n*	%			
Sex							
Male	38	92.7	3	7.3	0.128	1.16	0.94–1,44
Female	20	80.0	5	20.0			
Age							
≥ge yo	36	87.8	5	12.2	0.649	0.99	0.83–1,20
<60 yo	22	88.0	3	12.0			
Cycle							
<5	21	84.0	4	16.0	0.351	0.93	0.76–1.14
>5	37	90.2	4	9.8			
Asystole							
Yes	44	95.7	2	4.3	0.008*	1.37	1.02–1.83
No	14	70.0	6	30.0			
PEA							
Yes	3	50.0	3	50.0	0.020*	0.55	0.24–1.22
No	55	91.7	5	8.3			
VT/VF							
Yes	2	66.7	1	33.3	0.326	0.75	0.34–1.68
No	56	88.9	7	11.1			
Other							
Yes	9	81.8	2	18.2	0.399	0.92	0.28–1.23
No	49	89.1	6	10.9			
Malignancy							
Yes	1	100.0	0	0.0	0.879	1.14	1.04–1.25
No	57	87.7	8	12.3			
Sepsis							
Yes	20	100.0	0	0.0	0.045*	1.21	1.06–1.38
No	38	82.6	8	17.4			
Diabetes mellitus							
Yes	18	81.8	4	18.2	0.247	0.90	0.72–1.12
No	40	90.9	4	9.1			
Cardiogenic shock							
Yes	19	95.0	1	5.0	0.232	1.12	0.96–1.31
No	39	84.8	7	15.2			
Resp. Failure							
Yes	17	89.5	2	10.5	0.582	1.03	0.85–1.24
No	41	87.2	6	12.8			
CKD							
Yes	25	89.3	3	10.7	0.538	1.03	0.86–1.23
No	33	86.8	5	13.2			
Acidosis							
Yes	34	94.4	2	5.6	0.079	1.18	0.97–1.44
No	24	80.0	6	20.0			

*P<0.05

There is organ failure and dysfunction due to the response to infection or inflammation which can be life-threatening for the patient.[18] In septic shock and severe sepsis, even a DnR command is given in case of worsening of cardiac arrest.[19] Although further research is still required regarding the application of risk factors for unsuccessful CPR, the data obtained can be a strong consideration for whether CPR can be carried out, especially in patients with chronic diseases or a palliative status. Factors such as sepsis or septic shock, the male gender, signs of acidosis, and no heart rhythm or asystole can be checked to indicate the possibility of unsuccessful CPR. This study has several limitations because the data are only from medical records, so it is difficult to confirm with the medical team if there are doubts about the data. In addition, data were collected in one hospital for a short period of time, so the results may not be generalized.

Table 3: Risk factors for predicting death during CPR.

Condition	*P*-value	OR	CI 95%
Sepsis			
Yes	0.998	354950336	0-∞
No			
Sex			
Male	0.059	9.07	0.92–89.76
Female			
Acidosis			
Yes	0.092	8.09	0.71–91.93
No			
Asystole			
Yes	0.035*	7.83	1.16–52.76
No			

*$P<0.05$

Apart from some of the limitations of this study, the data obtained indicate that not all patients can receive CPR because of its low success, especially if several indicators are found, such as those in this study.

CONCLUSION

Sepsis or septic shock, the male gender, acidosis, and asystole rhythm can be determinants of mortality in patients with chronic diseases who undergo CPR. It is necessary for one to test the application of the checklist or data from other hospitals and score the predictive factors to make determination of the success of CPR easier.

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Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. World Health Organization. WHO Definition of Palliative Care. Geneva: World Health Organization; 2018. Available from: http://www.who.int/cancer/palliative/definition/en [Last accessed on 2018 Oct 22].
2. Connor SR, Bermedo MC. Global Atlas of Palliative Care at the End of Life. London: World Health Organization, Worldwide Palliative Care Alliance; 2014.
3. Willard C. Cardiopulmonary resuscitation for palliative care patients: A discussion of ethical issues. Palliat Med 2000;14:308-12.
4. Smith CB, Bunch OL. Do not resuscitate does not mean do not treat: How palliative care and other modalities can help facilitate communication about goals of care in advanced illness. Mt Sinai J Med 2008;75:460-5.
5. Fritz Z, Slowther AM, Perkins GD. Resuscitation policy should focus on the patient, not the decision. BMJ 2017;356:j813.
6. Cruz VM, Camalionte L, Caruso P. Factors associated with futile end-of-life intensive care in a cancer hospital. Am J Hosp Palliat Care 2015;32:329-34.
7. Marco CA. Ethical issues of resuscitation: An American perspective. Postgrad Med J 2005;81:608-12.
8. Head B, Ritchie CS, Smoot TM. Prognostication in hospice care: Can the palliative performance scale help? J Palliat Med 2005;8:492-502.
9. Llobera J, Esteva M, Rifà J, Benito E, Terrasa J, Rojas C. Terminal cancer: Duration and prediction of survival time. Eur J Cancer 2000;36:2036-43.
10. Hui D. Prognostication of survival in patients with advanced cancer: Predicting the unpredictable? Cancer Control 2015;22:489-97.
11. Andersen LW, Holmberg, MJ, Berg KM, Donnino MW, Granfeldt A. In-hospital cardiac arrest: A review. JAMA 2019;321:1200-10.
12. Ahmad AS, Mudasser S, Khan MN, Abdoun HN. Outcomes of cardiopulmonary resuscitation and estimation of healthcare costs in potential 'do not resuscitate' cases. Sultan Qaboos Univ Med J 2016;16:e27-34.
13. Choi Y, Kim JW, Suh KJ, Lim YJ, Lee JY, Kang BD. Identification of a potentially avoidable cardiopulmonary resuscitation in hematology and oncology wards. BMC Palliat Care 2019;18:93.
14. Jamme M, Ben HS, Guillemet L, Dupland P, Bougouin W, Charpentier J, et al. Severe metabolic acidosis after out of hospital cardiac arrest: Risk factors and association with outcome. Ann Intensive Care 2018;8:62.
15. Trehan K, Rotta S, Gregg SC, Glasgow K, Crombie RE, Cholewczynski WM, et al. Is pre-hospital CPR a risk factor for early death in patients transferred to an adult burn centre? J Am Coll Surg 2017;225:210-5.
16. Siriphuwanun V, Punjasawadwong Y, Lapisatepun W, Charuluxananan S, Uerpairojkit K. Prognostic factors for death and survival with or without complications in cardiac arrest patients receiving CPR within 24 hours of anesthesia for emergency surgery. Risk Manag Healthc Policy 2014;7:199-210.
17. Gyawali B, Ramakrishna K, Dhamoon AS. Sepsis: The evolution in definition, pathophysiology, and management. SAGE Open Med 2019;7.
18. Moskowitz A, Omar Y, Chase M, Lokhandwala S, Patel P, Andersen LW, et al. Reasons for death in patients with sepsis and septic shock. J Crit Care 2017;38:284-8.
19. Raj SK, Panda PK, Wig N, Agarwal P, Pandey RM. Compliance with 6 h-sepsis resuscitation bundle of surviving sepsis campaign before and after resident physicians' training: A quality improvement interventional study among Indian patients. Emerg Trauma Shock 2019;12:3-9.